ELECTRICAL WORLD
AND
Electrical Engineer.

ELECTRICAL WORLD, Vol. 33, No. 20. NEW YORK, MAY 20, 1899. ELECTRICAL ENGINEER, Vol. 27, No. 576.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(Incorporated).

120 LIBERTY STREET, NEW YORK.

Telephone Call: 4044 Cortlandt. Cable Address: Electrical, New York.

Chicago Office, - - - - - - - - 936 Monadnock Block.
Philadelphia Office, - - - - - - 929 Chestnut Street.

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United States, Canada or Mexico, - - - - - - - per year, $3.00
Foreign Countries within the Postal Union, - - - - - - - 6.00
Single Copies, - - - - - - - - - - - - - - - - - .10
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(Entered as second-class mail matter at the New York Post Office.)

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

NEW YORK, SATURDAY, MAY 20, 1899.

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The Coming National Electric Light Association Convention.

Within a little more than twelve years, the National Electric Light Association has witnessed a remarkable evolution of the art of which it is the official representative before the public, but perhaps at no previous stage was it confronted with more interesting questions and problems than its members will have brought to their notice next week at the convention which opens on Tuesday or by the exhibition which now fills Madison Square Garden with light, color and novelty. When it started in 1885-6, the association was frankly an arc lighting body, but at the very outset it began to take an interest in electric power, mainly on series circuits. Then came the necessity to go into the business of incandescent lighting. Then came the problems of day circuits and a steady load and soon followed the big questions of methods of distribution and of types of current.

Many of these chapters of association history are closed, and the mute memorials of many exciting incidents of the opening years hang in the historical arc lamp collection. But the questions whether to do incandescent lighting, to run day circuits, to do a power business, were in nowise more important than those which now await decision among which the first place must be assigned to the great new art of automobilism. Associated with these later questions are such as arise from the growing use of storage batteries and the nearer relationship thus established all around between the lighting and the traction industries.

The programme that has been prepared for the association, as printed already in our pages, is an excellent one, and if dealt with thoroughly will cause the convention to leave a deep imprint. The hospitality of the electrical fraternity in New York will also be freely extended, and we can only hope for a week of bright May weather to give the finishing touch to all the careful preparations that have been made under President Young's active guidance.

Street Railways For Nothing.

Mr. Tom Johnson informed the public recently that the good time was coming when street car rides would be free, under the conditions of municipal ownership which he advocates. It will be remembered that the City of Detroit resolved not long ago to operate street railways for itself and proceeded to take steps to buy out Mr. Johnson, who hitherto has found it necessary to get an average fare of something like four or five cents as a proper return of the investment of himself and friends. In order to help the city give street car rides for nothing to its citizens, Mr. Johnson was quite willing to let the system go, but he wanted $17,000,000 in 4 per cent bonds, the same to be a blanket mortgage over the entire assets of the Detroit Street Railway Commission and to be guaranteed by a kind of security franchise to run thirty years. The Commissioners, however, feel able to offer only $15,500,000, and on that basis think they can give three-cent fares, although the recent experience of the Detroit Lighting Commission with street lights would justify one

in assuming that the real cost of the fare under municipal ownership would be six cents.

The amusing part of the plan is that the law authorizing the purchase requires that the price shall be paid entirely out of the earnings of the roads, while Mr. Johnson, sticking out for his seventeen millions, insists that the streets cars should be as free as air to everybody. All that is needed now is a Detroit Water Commission to supply free water to everybody, and the city's fortune will be made. We regret that this view of the case does not prevail in Toledo, where Mayor Jones, who has the municipal ownership bee in his bonnet, and who was elected on an own-everything-free-to-everybody platform cannot get the city council to operate the Shore Line Railroad there. The councilmen are afraid of the proposition, as well they may be. When we see Tammany in New York giving a better and cheaper service to the citizens than the Metropolitan Street Railway Company is giving we promise to become red-hot Pingreeites or Jonesites or municipalites. But not till then.

The pertinence of the old saying that it depends whose ox is gored is seen in regard to this question in a little incident that has just occurred in a New Jersey town where the municipality has invested in a cow. The local milkmen are very much disgusted and are taking steps, it is said, to prevent the investment in another cow for butter purposes. It is understood that some of them had recently been in favor of municipal street railways, but of course this is different. So, too, out in Wichita, Kan. A local judge has just declared street cars to be a public nuisance, and yet Detroit and other places want to operate such a nuisance for themselves. Events of this character are rather provocative of smiles.

OVERLOAD CAPACITIES.

One great difficulty in the way of standardizing machinery lies in the insistence of many engineers upon unduly large reserve capacities in their electrical machinery. As a broad principle, there is nothing to be gained by this method of procedure, while, so far as it tends to check the standardization of manufacturer's types, it is pernicious and has a baneful effect upon the electrical industry at large. If the recognized full-load temperature elevation of a certain 200-kw generator is, say 50 degrees C. above the surrounding air, and if this temperature elevation can be shown to be perfectly safe with the materials employed in electrical machine construction, then there is no merit in ordering a 200-kw generator which will only heat 20 degrees C. above the surrounding air, or a 200-kw generator which will carry an over-load of 100 per cent. for three hours without exceeding 50 degrees C. elevation of temperature. The manufacturer can frequently meet such specifications by taking a 400-kw generator and altering its name-plate, or marking it down to 200-kw, but no one has been benefited by the change; whereas, if the manufacturer has to build a special size of machine to meet these conditions, everyone is discontented and delayed. If the parties ordering the generator had contented themselves with a standard size of generator worked to the ordinary full capacity with the ordinary latent capacity for over-loads, every one would have been benefited by conforming to standard practice.

A correlated question is as to what latent capacity for steady overload a generator ought to possess. It may be urged that a generator which will not raise its temperature more than 50 degrees C under continuous full load should always be capable of a certain over-load to meet contingencies. There is justice in this plea if the overload is to be regarded as a temporary one. If, however, the generator in question is rated at, say 500-kw, and is to be capable of delivering 600-kw steadily for an indefinite period without excessive temperature elevation—that is, at a temperature elevation that it can safely support—then the generator is clearly a 600-kw generator marked as a 500-kw generator; or, stated in another way, the manufacturer has under-rated his generator to suit the whim of his customer. It seems reasonable to assert, therefore, that no electric machines should be called upon to maintain an indefinitely extended over-load. All over-loads should be considered as necessarily temporary and limited in duration. Thus, incandescent lighting generators which have to meet the temporary demand for an evening hour, called the "peak" of the load, should be capable of delivering, say 25 per cent. extra power during this interval of extra demand. Similar reasoning applies to all classes of service. The occasion for latent over-load capacities usually does not exist in machines employed in telegraphy, telephony, electro-chemistry or electro-plating, these loads being usually steady, but there is considerable demand for temporary over-load capacity in electric railway and electric lighting work; while no machine can be expected to supply a continuous over-load without contradiction in terms and injury in fact.

TWO-PHASE VS. THREE PHASE SYSTEMS.

The discussion in these columns of the subject of two-phase vs. three-phase systems, and notably the letter from Mr. C. F. Guilbert on another page of this issue, have demonstrated the hair-splitting nature of the relative merits of what should not be called two systems, but two slightly differeing modifications of one system. Unfortunately, the term "two-phase" has misled the writer of the letter referred to, as no true two-phase system is used in this country, what we call a two-phase being really a four-phase system, or—as it has been commercially named by the largest company using it—a quarter-phase system. In both two and three-phase systems, polyphase transformers, such as the writer of the letter also mentions, are never used in this country, two single-phase transformers being always used with the two-phase system and three as a rule with the three-phase system, although power in the latter is sometimes transformed from the three compound circuits to three phases with two transformers connected upon what has been called the "Scott system."

As to the winding of armatures mentioned in the letter, it is true that the unitooth two-phase machine gives a greater output for the same core, flux and copper density than does the unitooth three-phase machine It also gives higher electromotive force per turn and requires fewer teeth than does the three-phase machine, both great advantages where unitooth machines are necessary, i.e., in the direct generation of high tension currents. However, high tension currents mean long transmissions, and the three-phase current gives a 25 per cent. greater copper economy, which on long transmissions more than balances the disadvantages of the three-phase unitooth generator. If transformers are included between the machine and the line, it becomes possible and desirable to distribute the windings upon the armature, and the advantage of the two-phase machine vanishes.

Taking up Mr. Guilbert's discussion of the effect of the number of phases in rotary converters, it has been pointed out heretofore in these columns by Mr. C. P. Steinmetz that—to take a specific example—a 100-ampere dynamo may be made to deliver, when used as a rotary, 134 amperes with three-phase supply and 164 amperes with two-phase supply, assuming unity power factor. It has also been pointed out that the same machine may be supplied from three transformers with six-phase current, increasing the output with the same heating to 196 amperes. It is also true that twelve phases may be delivered by three or even two transformers, increasing the output to 224 amperes with no increased losses except those of commutation.

In this country the chief objection to three phases as against the so-called two phases, has been the necessity of a smaller division of lighting loads, which are necessarily single-phase in their character.

A consistent carrying cut of the policy of complete parallel working would necessitate single-phase supply, while two phases (as we term them) require the division of the load into two approximately equal parts, and three phases into three parts, which is a trifle more difficult.

TRANSFORMER REGULATION.

The steady improvements which have been effected in the construction of alternating-current transformers of recent years, has enabled them to regulate much better; and, in a certain sense, regulation is of more importance in the distribution of incandescent lighting than is efficiency. Without reasonably good regulation, the station manager cannot give satisfaction to his subscribers at any price, whereas the question of efficiency resolves itself, from the station manager's standpoint, into the question as to what price will secure satisfaction to his customers. It is a remarkable fact that in spite of great endeavor, no satisfactory automatic pressure-regulator for a transformer has yet been found. In other words, while theoretically a step-down transformer should be capable of increasing its secondary terminal pressure with the load, the best that the designer can do is to prevent the secondary pressure from falling off more than a certain small percentage. A simple automatic compounding device for slightly raising the secondary terminal pressure of the transformer would be a great boon. For while it is quite possible at the present time to employ a device to raise the secondary pressure automatically, yet such devices as have been proposed or tried are troublesome and expensive.

The great advantage of a simple compounding device would be that it would give the designer of transformers a much freer hand and enable him to reduce the cost of the transformer itself. If it were possible to raise the pressure say, 10 per cent. at full load, then if the inherent regulation of the transformer without the auxiliary device was increased from say, 2 per cent., as at present necessitated, to say 6 per cent., the pressure would still rise 4 per cent. at full load, and the regulation of the transformer itself could be three times worse than it is without loss of efficiency.

When we consider the sensitiveness of the ordinary incandescent lamp with respect to the pressure at its terminals, it is wonderful that good satisfaction is ordinarily given. Two per cent. full-load regulation in a transformer is good at the present time, and 2 per cent. full-load regulation in house wiring is also very good. This represents about 4 per cent. drop of pressure at lamp terminals between no-load and full-load, or a lowering in candle-power of an ordinary 3.5 watt-per-candle lamp from 16 to about 12 candles. If we take into account incidental irregularities in the primary pressure, it is wonderful that so little dissatisfaction is given. Fortunately the human eye tends to accommodate itself to changes in illumination and is not able in the absence of a standard source of light closely to judge of the luminous intensity of incandescent lamps. In practice, with the transformers that are sometimes used, and the house wiring sometimes installed, the candle-power of lamps at full load sometimes falls from 16 at normal no-load to 8 or 9 at full load. It is customary, of course, to offset such lowerings of pressure and candle-power by raising the generated pressure at the station, until the average primary pressure at transformer terminals is in excess during the hours of full load. But this can only be considered as a palliation rather than a remedy, since the lamps then connected to transformers that may happen to be light-loaded, are burned at an unduly high pressure to their own detriment.. Consequently, while matters are surprisingly satisfactory considering the difficulties of the case, we can only echo the sentiments of the manufacturer aand station manager and say: Wanted: A simple, cheap, reliable, efficient booster for automatically raising the secondary pressures of step-down transformers under load.

THEORY OF WIRELESS TELEGRAPHY.

A want—if not long felt, none the less real—exists for a theory of wireless telegraphy, or, at least, a working hypothesis, which will satisfactorily explain the functions of some of the details that have been found indispensable by Marconi and others in the apparatus employed in practical wireless telegraphy. The academic theory of wireless telegraphy is simplicity itself. A disturbance in the ether set up at a spark gap is propagated through space in the same manner as light or heat waves. The electric radiations falling on a metallic powder normally non-conducting and forming part of an electrical circuit containing a telegraph instrument, cause the particles to cohere, thus rendering the mass conductive. When, however, we come to apply this theory to the practical apparatus, we find, apparently, it does not fit. First, a ground connection is necessary at one side of the receiver and transmitter. Second, an ærial conductor is required at the other side of these apparatus. Third, for highest efficiency a choke coil is found necessary in the electrical circuit of the coherer. In addition, a recent patent of Marconi describes as necessary a peculiar arrangement, consisting of a combined inductance and capacity in circuit with the recorder connection when the relay and coherer are encased in a metal box for protection of the former against the influence of a neighboring transmitter. A true inventor, Marconi seems to have concerned himself very little with the theory of wireless telegraphy, but has confined his work to experimental changes, thus arriving at dispositions regardless of any theory connected with them, which would improve the working of the apparatus. So far as we have followed Marconi's work, he is likely to continue devoting his attention to what may be called the engineering questions, leaving the more intimate philosophical aspects to others.

No theory, so far as we know, has been offered to explain the necessity of the choke coil in the coherer circuit, and one cannot see the necessity for introducing into the recorder circuit the peculiar device above noted. Several explanations have been offered as to the functions of the ærial conductor and ground connection, but unfortunately all of these strike at the beautiful academic theory of wireless telegraphy, based upon Hertzian waves radiating from the spark gap of the induction coil. Prof. Blondel considers that the ærial conductor and the earth connection play the part of the two plates of a condenser, which is charged by the coil and becomes the seat of an oscillatory current when the spark passes across the induction coil air gap. The oscillations thus set up in the ærial wire are not in themselves utilized, but give rise to disturbances in the surrounding ether which are propagated concentrically with respect to the vertical conductor, expanding horizontally until they strike the receiving ærial conductor at right angles, in which are then generated oscillations that affect the coherer at its base. In the article on the Italian Navy which recently appeared in our columns, another theory, due to Prof. Pasqualini, is given. According to this theory, the signal transmitted is the result entirely of the first half wave of an oscillatory discharge, the subsequent waves being without any influence in increasing the effect. Consequently, instead of attempting to produce oscillatory discharges, the endeavor should be to produce discharges which die out rapidly, in order that the first wave may have the greatest possible intensity. The conclusion of Prof. Pasqualini is that Marconi telegraphy is simply a phenomenon of electromagnetic induction, which produces an effect at a great distance on account of its high intensity and the extreme sensitiveness of the coherer. It should not be difficult to determine the degree of sensitiveness of the latter in terms of an electromagnetic field, and then experimentally and mathematically determine for comparison the strength at given distances, of the field set up from the ærial conductor. A series of experiments should also show the real function of the choke coil. It is to be hoped that these or similar investigations may soon be undertaken.

Preparations for the National Electric Light Association.

The following committees have been appointed by President A. M. Young in connection with the meeting next week of the National Electric Light Association at the electrical exhibition in Madison Square Garden, where the convention proceedings will take place in the concert hall: Reception committee, Thomas E. Murray, chairman; C. A. Schieren, H. L. Shippy, C. H. Jackson, L. F. Requa, G. T. Manson, J. W. Lieb, Jr., Paul Spencer, E. A. Leslie, E. H. Stevens, W. Brock, E. H. Maher, Jr., A. J. Purinton, A. H. Patterson, W. S. Barstow; entertainment committee, Chas. W. Price, chairman; W. L. Candee, T. Beran, W. F. Zimmerman, C. O. Baker, Jr., A. H. Patterson, E. F. Peck; automobile ride, E. F. Peck, C. O. Baker, Jr., A. H. Patterson, T. C. Martin, H. L. Shippy, J. W. Godfrey, Frederick Vieweg and Prof. G. F. Sever.

These various committees are doing active work for the care of the members and the ladies who accompany them. The automobile ride is planned for Wednesday afternoon, May 24, leaving the Garden at 2:30. The route will include Fifth avenue, Riverside Drive, Grant's Tomb, etc. The party have been invited to visit Columbia University and take afternoon tea in the West Hall, as well as to inspect the library with its unique scheme of lighting, the engineering buildings and the mechanical plant. On the return ride, the New York Electric Transportation Company has invited the party to visit its "stables" and see how the automobiles are furnished with motive power, how the batteries are charged, etc.

On Thursday, a special steamboat excursion will take the ladies up the North River as far as Yonkers, to give a view of the Palisades,, down through the Narrows past Tompkinsville, where Admiral Sampson's fleet is now anchored, up through the Buttermilk Channel, past the Navy Yard, returning in ample time for dinner.

The General Electric Company has extended an invitation to the active members of the association to visit its factories at Schenectady, and has arranged for a special train over the New York Central Railway on the morning of Friday, May 26. The train will return to New York about 10 o'clock the same evening.

A number of private entertainments and dinners have been planned also for the coming week, which promises to be in many social and technical respects a memorable one for the electrical industry and profession.

Twenty-Second Convention of the National Electric Light Association.

According to the programme prepared by President Young and Secretary Porter, for the twenty-second convention of the National Electric Light Association at Madison Square Garden, the following papers will be taken up: "Single-phase Distribution," by Herbert A. Wagner, St. Louis, Mo.; "Underground Electrical Construction," by Louis A. Ferguson, Chicago, Ill.; "Some Notes on Underground Distribution of Two-phase Current in New York City," by E. A. Leslie, New York City; "The Development of High-Tension Service" (illustrated by steropticon), by Calvin W. Rice; "A Local Transmission System—Development and Operation," by W. S. Barstow, Brooklyn, N. Y.; "Alternating-Current and Distribution—Changes Contemplated in Atlanta," by H. M. Atkinson, Atlanta, Ga.; "Means of Affording Safety in Electrical Distribution," by W. L. R. Emmet, Schenectady, N. Y.; "Rotary Transformers and Storage Batteries, and Their Relation to Long-Distance Transmission," by Professor C. E. Robb, Hartford, Conn.

The Murray Hill Hotel has been selected as the headquarters of the Association. The preparations for the entertainment of members and the ladies with them are noted in another article.

Important Riker Automobile Plans.

Great interest waas created in electrical automobile cycles this week by the rumor that Mr. A. L. Riker, who controls the Riker Electric Company, and is one of the foremost successful designers and builders of automobiles, had effected an important business arrangement with Messrs. C. A. Lieb and Oscar T. Crosby, looking to the increase of his facilities and the development of an enormous industry in this new field. The report proves to be true, and the Riker-Lieb-Crosby syndicate is already pushing its plans most vigorously. It has practically unlimited capital at its back, while the engineering and manufacturing skill of all the parties is too well known to need emphasis. Further interesting details of this important event are expected to become known in a week or two.

Prof. Jackson on Wisconsin University Laboratory Work.

During the past month, Prof. D. C. Jackson, head of the electrical engineering department of the University of Wisconsin, Madison, Wis., gave a lecture before the Chicago Electrical Association, on the electrical engineering laboratory work and methods carried out at the University of Wisconsin. The lecture was full of interest, not only to educators and students, but also to the large number of practical men assembled to hear him, for he outlined some of the original investigations going on at his institution which give promise of very important industrial results. The lecture was illustrated with stereopticon.

In introduction Prof. Jackson said that it was their great aim to train students to think and work for themselves, to work out their own problems rather than take what was prepared for them. Views were shown of the different rooms used by electrical engineering students. One interesting feature of the methods of instruction is the use of models of armatures wound in the various ways and so marked that the methods of winding are easily traced by students studying that subject. Prof. Jackson stated also that a 20,000-volt testing transformer is now used in regular class room work. The danger is fully appreciated, but it is thought best to accustom students to the use of such high voltages since they must now deal with them in practice.

Some of the most promising investigations and discoveries recently made at this institution are along electro-chemical lines, several of which were briefly mentioned.

One of the instructors has recently evolved a process for cleaning bicycle frames of spelter after the brazing operation during manufacture. It is an electro-chemical process and accomplishes the result very rapidly, as compared with present methods.

Some work has been done with the Wehnelt interrupter and a most peculiar discovery has been made, namely, that aluminum may be used as a substitute for the glass surrounding the platinum anode. Prof. Jackson accounts for the success of this plan by saying that aluminum is usually coated with a thin layer of oxide and that contrary to the general belief it is almost impossible to get a piece of aluminum not coated with oxide and impossible to keep it free from such coating. It is to this, he claims, that the difficulty of soldering aluminum is due.

By far the most interesting part of the lecture, however, related to results of tests to determine the effect of strain and variation in composition on the electro-chemical value of metals in the same structure. The first important fact noted was that the e. m. f. of a piece of iron or steel when put in an electrolytic cell rose very rapidly as the strain upon it increased. If the strain was raised above the elastic limit of the metal, the e. m. f. remained at its high value; but if the elastic limit was not reached the e. m. f. fell back as the strain was diminished. Investigations had not proceeded far enough to establish this as an absolute law, but they are far enough along so that they are tolerably sure of the principle. Prof. Jackson believes that this discovery will account for many cases of corrosion of iron structures, and, in fact, thinks that we may go farther than this and pronounce nearly all corrosion, electrolytic corrosion. For example in the case of plates which have been punched for rivet holes, there is often trouble, especially from corrosion around the rivet holes. This, he thinks, is due, no doubt, to the straining of the steel plate just around the rivet to above the elastic limit, thus raising its electro-chemical relation so as to produce a difference of potential between the strained part and the surrounding plate and electrolytic action as soon as moisture is present to form an electrolyte. In the same way, variations in the chemical composition of the steel in different parts of a piece of metal or structure may give rise to electrolytic action. The variations in the percentage of carbon, silicon, manganese and other elements in different parts of the steel structure he believed might seriously influence the corrosion on account of electrolytic action so that engineers might in future come to insist on more homogeneous steel in exposed work. Much of the corrosion and pitting of water pipes underground he thought due to electrolytic action, not from outside sources, but between different spots on the pipes themselves. Considerable use is made at the institution of the capillary electrometer as a substitute for the galvanometer.

Transformer Core Losses.

BY PROF. W. ELWELL GOLDSBOROUGH.

AT a time of great commercial activity, when new enterprises are the order of the time, and new life is thereby instilled into old ones, it becomes a matter of importance to the financier and the manager alike not to misjudge the signs of the times and thereby be led astray in an energetic endeavor to obtain more productive and economic methods. Since we are passing through a period of reconstruction in the field of electrical activity as in others, many men are at this moment confronted by most intricate problems involving the expenditure of funds in the renovation of plants, and of these, those who are engaged in the distribution of power by alternating currents have not the least perplexing conditions to face. Alternating current distribution, in a large sense, is just entering the field of commerce. A few years ago it was not even regarded as a competitor of direct-current distribution where motor power was involved, where as now many direct-current systems are relying entirely upon alternating current generating stations for their supply of power.

The advent of the single-phase induction motor, and its introduction in its present form is only a suggestion of what is coming. As in the case of the multi-phase motors, so will the single-phase motor grow in the power of single units and in efficiency. The day load of the single-phase lighting system need no longer be a myth where energy and business sagacity are combined in securing its realization. The system that has accomplished so much in educating the public to a just appreciation of the usefulness of electricity has still a great future before it as the time of close competition draws near, and it is for the central station men to look to it that their plants shall not fall behind in the march of progress.

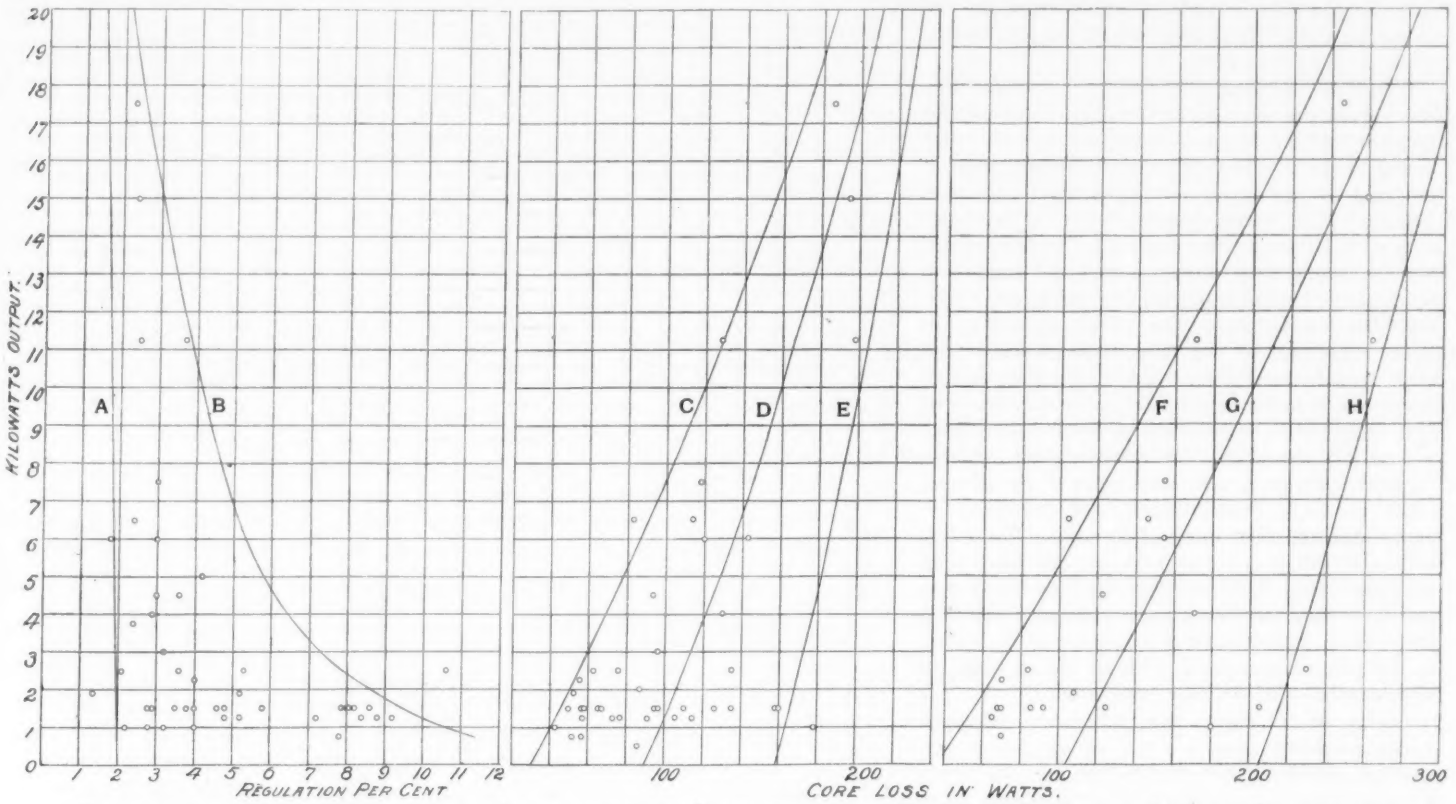
At the pulse of every alternating current system stands the transformer; a piece of apparatus that makes or mars the earning capacity of plants in just the measure of the skill employed in its use. It embodies in the simplest and most direct manner the principle that makes almost everything that is electrical possible, and it stands as the key to almost every problem of importance confronting our electrical engineers to-day. Is it then strange that so much time and attention have been devoted to perfecting the design of this piece of apparatus? Is it remarkable that our manufacturing firms specify in most minute detail every factor pertaining to the efficiency of their apparatus? But is it not queer that the average central station manager holds on to antiquated types of the transformer with a persistancy that is out of all proportion to any sentiment he can rationally be supposed to entertain regarding them?

With the remarkable record of improved conditions that have been shown to exist in one of our western cities by Mr. W. F. White, of Omaha,* as the direct result of a judicious and systematic supplementation of old by new apparatus, it is hardly to be supposed that inferior apparatus will be much longer tolerated. Those who utilize the transformer have only to make themselves conversant with its possibilities to the extent of formulating an equitable demand for specific economic performance, and it is no longer questionable, but that their specifications will be met by our American manufactures.

In looking over the numerous tests reported from scientifically reputable sources within the past eight years, I have been much impressed with the progress that has been made in transformer design. In some cases, by comparasion with modern apparatus, original types can hardly be said to have been possessed at all of those very important characteristics, efficiency and regulation. The cure for the latter of these defects has been more copper, the cure for the former more copper and better grades of core metal.

Some interesting observations will repay a glance at the data plotted in Figs. 1 and 2. Fig. 1 exhibits the regulation of forty-four transformers as reported by Ryan, Ford, Hopkinson and others, besides results obtained in the laboratories of Purdue University on twenty-one transformers, ranging in capacity from 750 watts to 5000 watts. These transformers were built between the years 1891 and 1895 and show a variation in regulation at 125 cycles of from 1.5 to 11 per cent., as indicated by the curves *A* and *B*. The transformers giving the poorest regulation are certainly bad enough and yet are no worse than many others like them, still at large. When it is remembered that 3 per cent. is poor regulation for even the smallest of our modern transformers, and that transformers of 600 watts capacity can be obtained having a regulation of 2.5 per cent., it is folly to perpetuate the life of appliances that can but bring discontent to the consumer and necessitate frequent lamp renewals. The 5-kw transformer shown as having a regulation of 4.2 per cent., was built as late as 1895 and just comes within the limit of time allowed to the chart. On the other hand none of the transformers are old as compared with the probable life of a modern transformer, they are simply old in the light of the developments in the art of transformer design.

In Fig. 2, are plotted the core losses recorded against all of the transformers mentioned upon which data is obtainable. The line *D* is taken as representing the average of the results, while *E* shows the probable maximum of the most aggravated cases we are likely to meet with in practice. Quite a few of these transformers are old campaigners, that have seen continuous service for at least three



FIGS. 1 AND 2.—REGULATION TESTS OF 1891-95, 125-CYCLE TRANSFORMERS. FIG. 3.—REGULATION OF 60-CYCLE TRANSFORMERS.

years. They are not, of course, to be compared with transformers that have been in continuous service for the last eight years, but they serve as examples. The most pronounced evidence of the bad methods that have prevailed is the record against the 1-kw transformer having a core loss equal to 17.8 per cent. of its capacity. The curve *D* shows that the average core losses in the older types of transformers amount to from 1 per cent. to 9.7 per cent. of the full load rating of transformers having a capacity of from 20-kw to 1-kw respectively.

On the other hand the curves given in Fig. 4, exhibit what may be expected of our modern transformers for 125-cycle working. The plotted points represent the guarantees that are made by our four most prominent transformer manufactures. The average core losses, as shown by the curve *J*, vary between the narrow limits of .8 and 2.6 per cent. for the given range; and while these figures indicate a substantial improvement in the larger sizes of the transformer, they show a remarkable improvement in the smaller sizes, averaging, indeed, an increased economy based on their full load capacity of 7.1 per cent.

I have made the 1-kw or 20-light transformer the lower limit of my comparison in connection with Fig. 2 because it represents fairly well the average practice of a few years. If we take the 500-watt or 10-light transformers as the comparison unit the average percentage increase in economy is 15.2 per cent.

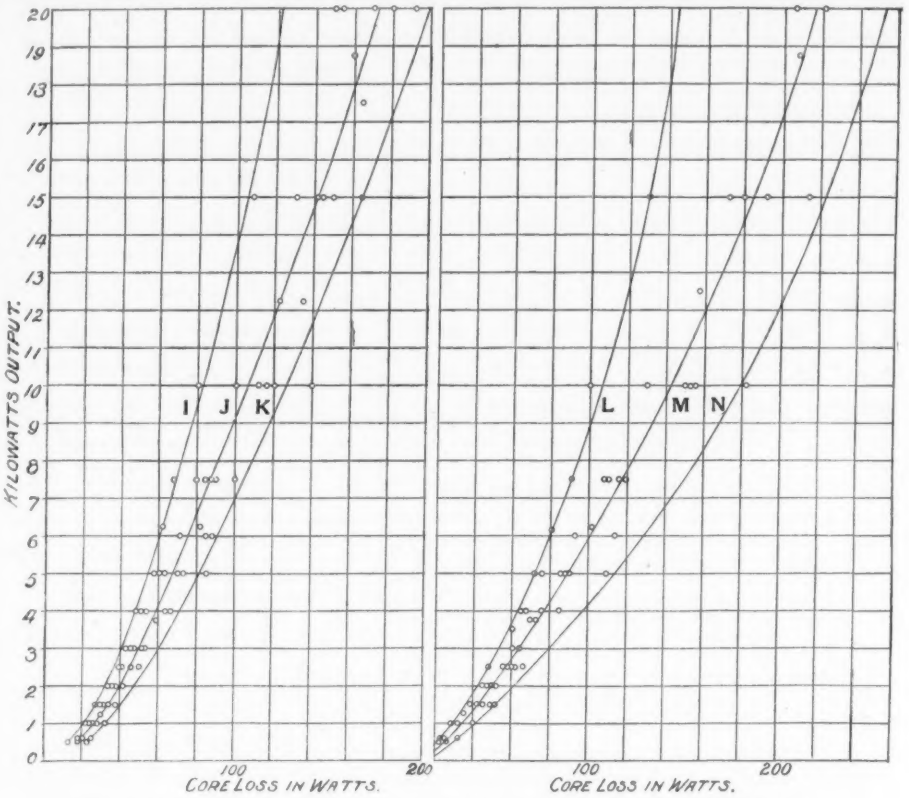
Where the working of the 60-cycle transformers is involved the discrepancy between the performformance of the old and new types is even more to the credit of the modern transformers than in the case of the 125-cycle transformers just considered. This comes largely from the fact that only within the past few years has the demand for low frequency transformers been great enough to warrant the manufacturers in bringing out a distinctively low frequency type. Such records as we have, therefore, of the past performance of 60-cycle transformers are records of tests upon high frequency transformers made under conditions of low frequency. The results presented in Fig. 3 are of this character. The plotted points, except in a few instances, are the records of actual tests upon 125-cycle transformers built between the years 1891 and 1895, made at 60 cycles. For a few of the larger transformers the results have been estimated from tests at high frequencies, as now low frequency test records are vailable. The step involved in these estimates meets the requirements of the present discussion with an amply sufficient approximation of the true core losses.

Owing to the higher core flux densities necessarily resulting from the use of the lower frequency currents, the core losses are uniformly higher. The average variation is between 1.4 per cent.of the total output for 20-kw transformers, and 11.3 per cent. for 1-kw transformers, with the curve *G* presenting a very conservative mean. The maximum variation that may be met with, between the same limits, is within 1.6 and 21.3 per cent. Where we think of a possible loss of 21.3 per cent. in core losses alone with transformers working under full load conditions, the proposition seems absurd. It is absurd, fortunately, in a sense, as anything so bad is not often met with.

As an aid to a ready application of these suggestions to the actual conditions that pertain to any given plant, the figures tabulated in Tables I. and II. are given as showing the average and the maximum gain in efficiency that may be expected when old transformers are replaced by new ones. As an example, referring to Table I, if ten 1.5-kw transformers are replaced by one 15-kw transformer, there will be a saving in power supplied under full load working conditions amounting in an average case to 5.8 per cent. of the supply or to 870 watts. If the transformers are connected in circuit all the time the saving in core losses per year would be 7620 kw-hours per year, or a saving of $152 per year on the baisis of 2 cents per kw-hour. At 6 per cent. this saving represents the interest on $2500. On the other hand, the maximum saving is not likely to go above 10.2 per cent. or $268 per year on the same baisis, even when the best modern 15-kw transformer is substituted for the worst of the old 1.5-kw transformers. And in view of the fact that the best of the old transformers are very nearly as good as the worst of our modern transformers, the saving in some cases will be considerably below, rather than above, $152.

The smaller figures of each set are the important ones, as they measure the *average* percentage gain on the baisis of full load working. The larger figures represent the maximum gain that is ever likely to be reached. They are based upon values selected from the curves *E* and *I* and are an indication of the relative gain in core loss economy between the worst of the old and the best of the new transformers. In as much as the curves *C* and *K* partly overlap, the mimimum percentage gain of the worst of the new transformers over the best of the old transformers is practically zero.

The greatest gain naturally follows from the substitution of modern 20-kw transformers for old .5-kw transformers where the average gain may reasonally be expected to reach 18 per cent. of the power involved under full load conditions. Under a condition of service involving four hours per day at full load and 20 hours per day at no load, the saving would be 51 per cent. of the primary power supplied during the entire twenty-four hours. This estimate is not beyond reason since the units considered may be taken to represent the extremes of practice, and since, as Mr. White has



FIGS. 4 AND 5.—CORE LOSSES OF MODERN 125 AND 60-CYCLE TRANSFORMERS.

told us in his article already referred to, 43 per cent. of the primary output of 1894 was saved in a station generating 400-kw by carrying out a plan of judicious substitution where all sizes of old transformers were involved.

I do not wish it to be inferred from what has been said so far that I advocate only the use of very large transformers. Other things being equal the larger they are the better. But even in isolated cases, much improvement can usually be made both in regulation and economy by the removal of the old types of transformers; and from 4 to 8 per cent. of the primary power supplied when working continuously at full load can usually be saved, or from 20 to 35 per cent. on the ordinary twenty-four-hour lighting schedule.

Table II. is in all respects similar to Table I, except that it applies to 60-cycle working instead of 125-cycle working. The figures here given are to be applied in the same manner in making calculations to improve economy, and show that a uniformly greater gain may be expected in the case of the lower frquency, in instances similar to those already discussed, in the ratio of about 10 to 9. It may be well to notice here what is really meant by a saving of 20 per cent. (a figure that occurs frequently in this table) in primary power supplied under full load conditions, by reducing it to the

*W. F. White, "Alternating Current Transformer from the Station Manager's Viewpoint," Transactions Am. Inst. Elec. Engrs., Vol. 15, 1898.

4-hour full load 20-hour no load basis of computation. By reference to the curves of fiigure 3, it will be seen that it means an average saving of 50 per cent. of the power supplied from the primary mains.

The large core losses that are shown to exist in many of the older types of transformers are undoubtedly due in a large measure to the so-called "ageing" of the core iron that has gone on constantly during the life of the transformer. That in the past this has been a very serious defect can readily be demonstrated by reference to the published records of tests* and the testimony of numerous scientists,† who have done much valuable work in investigating this effect and in pointing out its limitations. The results so far presented indicate clearly that the increase in the hystersis loss is due directly to heating the iron to temperatures above that of the surrounding air, and that with certain grades of material this effect is noticeable with changes in the temperature of the sample of but a very few degrees centigrade. On the other hand it seems now to be a fact that iron can be obtained by transformer manufacturers in sufficiently large quantities, that is non-ageing, to justify claims of superiority in this respect. I say this advisedly, in as much as I have conducted ageing tests upon samples of iron supplied me by

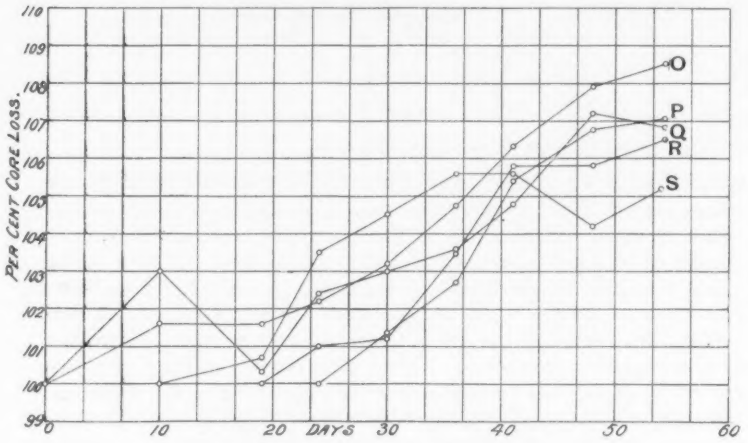


FIG. 6.—AGEING TESTS OF 1896 TRANSFORMERS.

five different firms within the past six months and have detected no appreciable increase in the hysteretic co-efficient of the samples, although temperatures as high as 75° C. have been maintained.

The old transformers showing an increase in temperature of as much as 75° C. above the atmosphere have already outlived their usefulness. They are not only destroying their insulation and thereby becoming a greater and greater menace to the property which they supply, but they are constantly losing in economy. The manner in which this goes on is variously shown in the curves of figure 6. These curves show the percentage gain in the core losses of five transformers subjected to a test of fifty-four days duration. They are not examples of serious ageing by any means. The transformers tested were built in 1896, and are of representative types. They show good efficiency and regulation and their initial core losses are not high. The percentages refer, of course, to the increase above the initial core loss, and not the percentage increase as compared with the full load output of the transformers. In our modern high grade transformers an increase of say 5 per cent. in the initial core losses due to ageing means an increase of from .18 of 1 per cent. to .05 of 1 per cent. in the losses of the transformer calculated on the basis of its full load capacity and for sizes throughout the entire range discussed in Table I. Though these values are small in comparison with the magnitude of the losses I have been discussing, even they must not be neglected, as already pointed out,* where high cost of power demands the highest economy.

Is it necessary to further enlarge upon the benefits to be gained by a judicious weeding out of bad material found in central station work? By making changes on the basis of the cost of power per kw-hour, all charges against the plant included, and adjusting the modifications strictly to the conditions to be met, no mistake can be made, and managers should cease to hesitate to take advantage of every opportunity to put their plants on a good paying basis. One in which good service will result from good regulation and a proper regard for the amount of copper in the primary and secondary mains. One in which the service can be extended without an increase in the number or power of the station generating units. One in which, with reduced losses and greater capacity, subscribers rates can be lowered and the service brought more generally within the reach of possible consumers; and finally one which, by the reliability of the service and the freedom from burnouts, will gain the confidence of the public.

*G. W. Partridge, London Electrician, Dec. 7, 1894.
†J. A. Fleming, London Electrician, Dec. 14, 1894.
W. M. Mordey, London Electrician, Dec. 21, 1894, Feb. 22, and March 1, 1895.
D. K. Morris, London Electrician, May 28, 1897, and J. A. Fleming, Oct. 22, 1897.
S. R. Roget, London Electrician, May 20, 1898, and Feb. 10, 1899.
*"Transformer Economy." Proceedings Nat. Elec. Light Association, 1898; Electrical World, June 25, 1898; Electrical Engineer, July 7, 1898.

TABLE I.

Average and maximum percentage increase in economy to be obtained by substituting modern for old 125-cycle transformers.

K. W.	.5	1.0	1.5	2.	2.5	3.	4.	5.	6.	7.5	10.	15.	20.
.5	15.2 29.0	16.1 30.1	16.5 30.4	16.8 30.6	17.1 30.7	17.1 30.9	17.3 31.0	17.5 31.1	17.6 31.2	17.7 31.3	17.7 31.4	17.9 31.5	18.0 31.6
1.0	..	7.1 14.3	7.5 14.6	7.8 14.8	8.0 14.9	8.1 15.1	8.3 15.2	8.4 15.3	8.5 15.4	8.6 15.5	8.7 15.6	8.6 15.7	8.9 15.8
1.5	....	....	4.5 9.3	4.8 9.5	5.0 9.6	5.1 9.7	5.3 9.9	5.4 10.0	5.5 10.1	5.6 10.2	5.7 10.3	5.8 10.4	6.0 10.5
2.	...	....	....	3.3 6.8	3.4 6.9	3.6 7.1	3.8 7.2	3.9 7.3	4.0 7.4	4.1 7.5	4.2 7.6	4.3 7.7	4.4 7.8
2.5	....	....	...	....	2.6 5.3	2.7 5.5	2.9 5.6	3.0 5.7	3.1 5.8	3.2 5.9	3.3 6.0	3.4 6.2	3.5 6.3
3.	....	....	....	....	....	2.1 4.4	2.3 4.6	2.4 4.7	2.5 4.8	2.6 4.9	2.7 4.9	2.8 5.0	2.9 5.1
4.	..	...	....	....	...	....	1.6 3.2	1.7 3.3	1.8 3.4	1.9 3.5	2.0 3.6	2.1 3.7	2.2 3.8
5.	....	....	....	....	....	....	....	1.2 2.5	1.3 2.6	1.4 2.7	1.5 2.8	1.6 2.9	1.7 3.0
6.	..	...	....	....		....	....	....	1.0 2.1	1.1 2.2	1.2 2.3	1.3 2.4	1.4 2.5
7.5	....	....	....	...	....	....	....	....	....	.8 1.6	.9 1.7	1.0 1.8	1.1 1.9
10.	....	...	....	...	..	....	....	....	....	....	.5 1.2	.6 1.3	.7 1.4
15.	....	....	..	..	....	....	....	...	...	....	....	.3 .7	.4 .8
20.	....	....	....	....	..	....	...	....	....	...	....	....	.2 .6

TABLE II.

Average and maximum percentage increase in economy to be obtained by substituting modern for old 60-cycle transformers.

K. W.	.5	1.	1.5	2.	2.5	3.	4.	5.	6.	7.5	10.	15.	20.0
.5	16.7 37.6	18.1 39.0	18.6 39.5	19.1 39.8	19.3 40.0	19.4 40.2	19.6 40.4	19.8 40.6	19.9 40.7	20.0 40.8	20.2 40.9	20.4 41.1	20.6 41.3
1.	....	7.8 18.3	8.5 18.9	8.8 19.1	9.0 19.3	9.2 19.5	9.4 19.7	9.5 19.9	9.6 20.0	9.8 20.1	9.9 20.2	10.1 20.4	10.2 20.6
1.5	....	....	5.1 11.9	5.5 12.3	5.6 12.4	5.8 12.6	5.9 12.8	6.1 13.0	6.2 13.1	6.4 13.2	6.6 13.4	6.7 13.5	6.8 13.6
2.	....	..	....	3.7 8.8	3.9 9.0	4.1 9.2	4.3 9.3	4.4 9.5	4.5 9.6	4.6 9.7	4.8 9.9	4.9 10.0	5.1 10.3
2.5	....	....	....	...	2.8 6.9	3.0 7.1	3.2 7.3	3.4 7.4	3.5 7.5	3.6 7.7	3.7 7.9	3.9 8.0	4.0 8.1
3.	....	....	....	....	...	2.3 5.7	2.5 5.9	2.7 6.0	2.8 6.2	2.9 6.3	3.0 6.4	3.2 6.6	3.4 6.8
4.	....	....	....	..	....	...	1.7 4.2	1.8 4.3	1.9 4.4	2.1 4.6	2.3 4.8	2.4 4.9	2.5 5.0
5.	....	....	...	....	...	....	....	1.3 3.3	1.4 3.4	1.5 3.5	1.6 3.7	1.8 3.8	2.0 4.0
6.	....	....	....	..	..	....	....	....	1.0 2.7	1.1 2.8	1.3 3.0	1.5 3.2	1.7 3.3
7.5	....	....	...	....	....	...	....	....	....	.8 2.1	1.0 2.3	1.2 2.4	1.3 2.6
10.	....		....	....	....	....	...	....	...	....	.6 1.6	.8 1.8	.9 1.9
15.	....	....	...	....	....	....	....	....	..	....	....	.4 1.1	.6 1.4
20.	....	....	....	....	...	....	...	...	....	....	....	....	.3 .9

Long Distance Telephony to Mexico.

At the annual meeting of the Mexican Telephone Company the matter of improving telephone facilities between Mexico and this country was brought up for consideration and discussed. At present there is no long distance line established between the two countries, and in order to make any change in earning capacity of the company this step would be the first to take. The Mexican government has refused all requests with reference to long distance connections. This government has been appealed to and the matter has been referred to the Secretary of State and will be acted upon in due time. It is claimed that with international telephone communication it would be to the advantage of both this country as well as Mexico.

Regulation as Affected by Leading and Lagging Currents.

BY FRANK G. BAUM.

It is a well-known fact that a lagging current interferes with, and a leading current improves, the regulation of an alternating current constant potential dynamo. A simple graphical method for showing the effect of lagging and leading currents on regulation of constant potential alternating current dynamo is here given:

First, let us suppose the current to be in phase with the e. m. f. (a sine wave being assumed). When the coil (a two-pole field is taken for simplicity) is in the position *op*, Fig. 1, the current will be proportional to the projection of *op* on *o Q*, that is *op*. The magnetizing force of this current will have the direction *op'* at right angles to *oP*. If *op* be taken as proportional to the magnetizing force of the coil in the position *op*, it may be shown that the locus of the magnetomotive force is the circle *op*¹ *A*. Let *o o'* represent the magnetomotive force of the field windings on the same scale that *op* represents the magnetomotive force of the coil; then *o' p* will represent the resultant magnetomotive force in magnitude and direction. It will be seen that the average value of the magnetic flux will remain the same; the effect of the coil being to slightly distort the e. m. f. wave.

Suppose, now, the current to lag, reaching a maximum value when the coil is in the position *o Q*, Fig 2. The locus of the magnetomotive force may now be shown to be the circle *op' A*. The circle in the first figure has been shifted through an angle equal to the angle of lag. The average value of *o' p* is now reduced, and, hence, the e. m. f. produced by the dynamo will be decreased.

If the current is leading we get the effect as shown in Fig. 3. Here the current reaches its maximum when the coil is in the position *o Q*. The locus of the magnetomotive force is the circle *o p'A*. The average value of the m. m. f. is increased, and, hence, the e. m. f. of the dynamo will be increased for a leading current. The e. m. f. will be increased nearly in proportion to the circuit current.

Columbia University Power Plant.

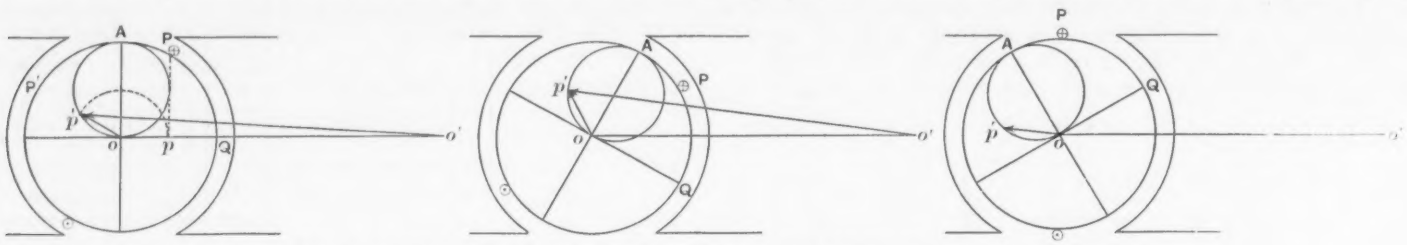
Mr. E. A. Darling presented at the Washington meeting of the American Society of Mechanical Engineers a paper entitled "The Power Plant of a University," which describes in full detail the new power plant recently installed for Columbia University at New York. The paper, as printed, is accompanied b numerous plans showing all the details of the plant. Seventeen Babcock & Wilcox boilers are used, having a total grate area of 825 square feet. The electric generating plant consists of a 600-hp simple Corliss engine driving a 400-kw generator at 90 revolutions per minute; two 300-hp simple Corliss engines driving 200-kw generators at 100 revolutions per minute; two cross-compound high-speed engines driving 75-kw generators at 260 revolutions per minute, and one 50-hp gas engine driving a 30-kw generator. The complete power plant and its connections cost at the rate of $50 per horse power. The heating and ventilating equipment and the electric wiring of the entire group of buildings will foot up to $550,000. The total cost for the complete engineering equipment, exclusive of drainage and plumbing, will be $1,100,000. When the entire equipment is completed, the engineering equipment will represent about 10 per cent. of the total investment. At least 4000 nominal boiler horse power will then be required and 1500 electrical horse power, and the coal consumption will reach 15,000 tons per annum. It is somewhat curious to note that more current is used for driving the ventilation fans than is used for light. This plant is to be visited by the National Electric Light Association on Wednesday, May 24, in connection with the automobile ride for the ladies.

Special Types of Alternators.

BY LIEUT. F. JARVIS PATTEN.

Figs. 1 and 2 herewith, published in recent issues of your paper, show respectively a slow-speed alternating current generator (Union Elektricitäts Gessellschaft), and an alternating current telegraph generator (Squier and Crehore), both the subject of recent patents implying novelty of invention. Both these systems were reduced by me to practice in 1888 and 1889, and though the slow speed alternator was once made by me precisely as shown in your published description, it was patented to me in the form shown in Fig. 3, in 1889, which amounts practically to the same thing as the system of connections shown in Fig. 1.

In the system used by me as a slow speed alternating current synchronizing motor, an ordinary two-pole direct current Gramme ring dynamo is taken, and alternate quarters of the points of the winding are reverse connected, while the intermediate quarters are left connected direct in the usual way. The system is plainly understood from an examination of Fig. 3, where segments 1, 2, 2 of quarter 7, 8, 9 are connected to points of the ring winding in the usual way; the intermediate segments 4, 5, 6 and 10, 11, 12 being connected to points of the winding diametrically opposite the segments, thus reversing the direction of the current from the brushes at every quarter revolution. This machine will evidently give two complete alternating current waves per revolution of the armature. It is a matter of comparatively simple mathematical demonstration to show that the current delivered by such a system of armature connections will not yield a pulsating or abruptly reversing current, as might at first seem probable, but a sine wave alternating current.



FIGS. 1, 2 AND 3.—DIAGRAMS SHOWING EFFECT OF LEADING AND LAGGING CURRENTS.

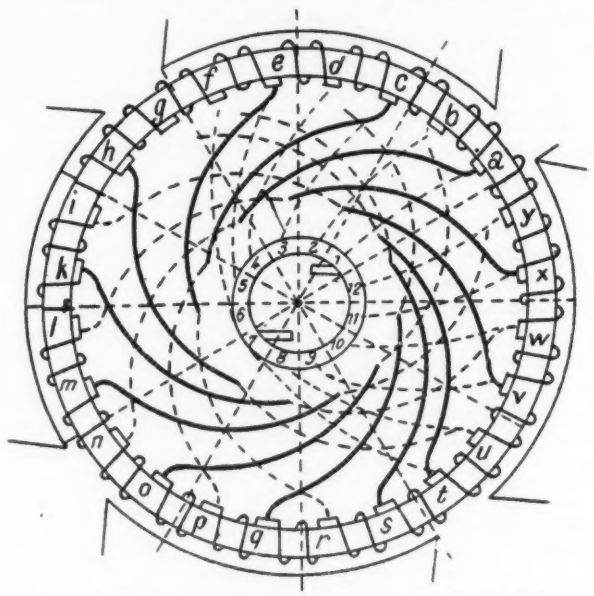


FIG. 1.—GERMAN ALTERNATOR FOR HIGH FREQUENCY.

The simplest type has been selected for illustration. It is evident, however, that taking a direct current machine having a multiple of twelve segments in its commutator, as 72 to 96, it can be broken into any number of groups of 3, 4, 6 or 12, each alternately reverse and direct connected and any desired number of waves per revolution obtained.

Of all slow speed alternators, however, doubtless the simplest is that described in these columns in 1892, under "Laboratory Notes," in which two opposite parts of the commutator are connected each to an independent sliding ring contact, on which bear the two brushes instead of on the commutator when direct current is desired. This system gives a perfect sine wave per revolution.

In further developments of these different modifications of the direct current machine, I made the variation shown in Fig. 4, for obtaining sine wave currents of one direction or sign only, the

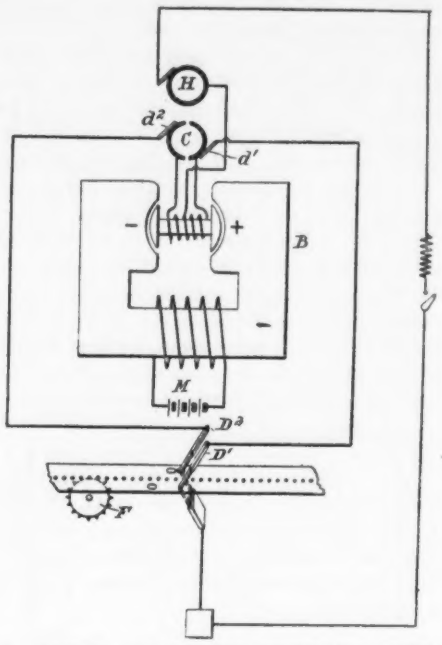


FIG. 2.—SQUIER AND CREHORE TELEGRAPH GENERATOR.

equivalent in fact of an alternating current with all the minus or all the plus half waves reversed, as *A, B, C*, Fig. 5, or *A, B*, same figure.

Such a result is best obtained by connecting an independent sliding ring contact, *R*, to one segment of the commutator as shown in Fig. 4.

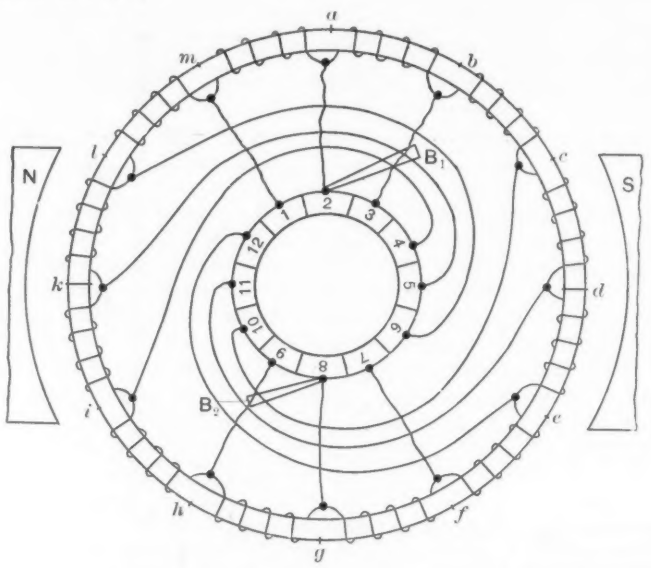


FIG. 3.—SLOW-SPEED ALTERNATING-CURRENT SYNCHRONIZING MOTOR.

Then in a circuit connecting the brush *B*, bearing on the commutator to brush, *B*, bearing on the ring, *R*, we will have a true sine wave pulsating current such as *A, B, C*, Fig. 5, because the voltage at any point of the revolution will be represented by the

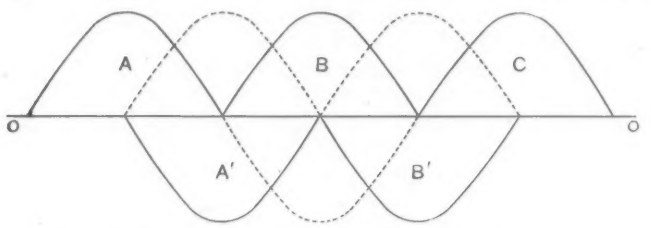


FIG. 5.—PULSATING CURRENTS OF OPPOSITE DIRECTION.

chord, *v, y, z*, drawn from *o* as an origin, and representing half the angular distance or arc through which the armature has revolved and this, it is easy to demonstrate, gives the ordinates of a true sine curve and not a pulsating curve.

If two rings, *R* and *R*, are connected to diametrically opposite segments of the commutator, then in circuits connecting the commutator brush, *B*, to two brushes on the different rings, we will have two pulsating currents of opposite direction, as *A, B, C*, and

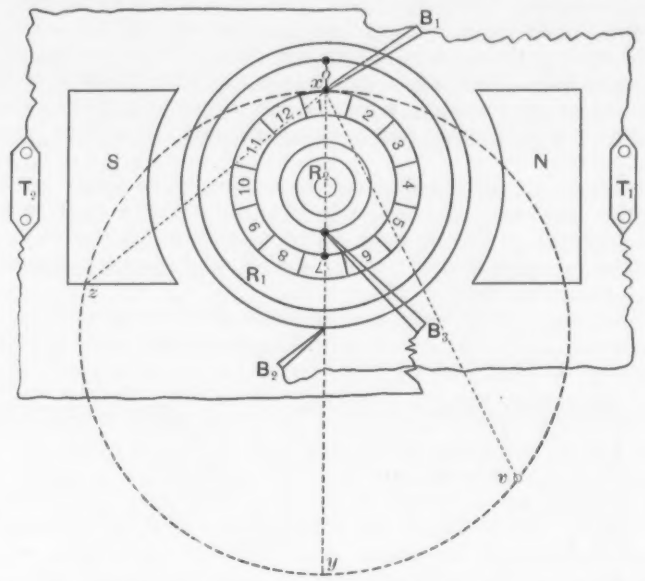


FIG. 4.—GENERATOR FOR OBTAINING PULSATING CURRENTS OF OPPOSITE DIRECTION.

A, C, Fig. 5. It is to be noted in this instance that a single pulsation, as *A* or *B*, corresponds to a complete revolution of the armature, and let opposite halves of the rings be blank or dead, we will derive in the two translating circuits, T and T, the plus waves and minus waves only of a true alternating current which has a frequency corresponding to one complete wave per two revolutions of the armature in a two-pole or single field, a much lower frequency even than those previously referred to.

This device evidently yields the same result as that shown in the recent patented device of Fig. 2, and gives one-fourth the frequency for the same speed as the Berlin alternator of Fig. 1.

Electrical Notes from Japan—I.

BY PROFESSOR F. B. CROCKER.

BEFORE leaving New York on a westward tour around the world I was often told there would be little or nothing of electrical interest until Europe was reached. Three months experience in Japan and China proved this to be an assumption, quite natural, but far from the truth. The applications of electricity in these countries, especially in Japan, are by no means insignificant at the present time, and are destined to be very extensive in the future. Furthermore, one is constantly struck with points which are nearly always strange and often important. The mere fact that Japan and China obtain the greater part of their electrical apparatus as well as methods from the United States is in itself sufficient to interest us in what they are doing.

For these reasons, I shall endeavor to send home a few letters briefly describing the status of electrical affairs in the various countries. These notes will be superficial in consequence of the conditions of migration under which they are written, but since he who runs may read, it is to be presumed that he who travels may write—at any rate he often does. This privilege becomes an inalienable right when one is quarantined for eleven days. Even Manila Bay with all its soul-stirring interest to an American, begins to lose some of its novelty, to say the least, after one has gazed upon it twelve hours a day for a week. Hence I am forced to write and transfer to my electrical brethren at home a share in my surplus of ennui.

Let us consider first electrical matters in Japan, grouping them under the eight heads—telegraph, telephone, electric light, electric power, electric railway, electrical manufacturing and electrical education. The first five are the most important applications of electricity in the chronological order of their development, which, it is interesting to note, is the same for America, Europe and Japan. We shall see that the last-named country has already brought telegraphy, telephony and electric lighting to a fairly advanced state, and is making excellent progress with the other branches. In China and in

India, the telegraph is the only electrical art that has been developed to a condition of importance. All the others are not as far ahead as they were in the United States A. D. 1884, and not much more advanced than they were in 1884 B. C., which, by the way, would not be considered a very early date in those two time-ignoring empires, Joshua caused the sun to stand still for one day. China and India have arrested the progress of time for three or four thousand years. Japan, a mere debutante in comparison, her history only extending back twenty-five hundred years, has experienced enormous changes and is now progressing rapidly along the lines followed by Europe and America.

Whether we call it imitation, adaptability or the ability to profit by the experience of others, this fact is certainly a most striking characteristic of the Japanese, being responsible for the enormous changes wrought in their country since it was opened to the world by Commodore Perry in 1854.

The telegraph in Japan, and telephone also, are operated by the government, as is the case in most European and Asiatic countries. They are included with the postal service in the Department of Posts and Telegraphs, which is under the control of the Minister of Communications. The telegraph lines extend the length and breadth of the empire, connecting all the larger towns as well as many of the smaller ones. The distances are very considerable, a straight line from Nagasaki, the chief city near the southwestern extremity of the island of Kyushu, to the most northern point of the island of Yeso, being about 1200 miles. The length of the telegraph lines is much greater than this, and includes several sections of submarine cable where it is necessary to pass from one island to another. The existing lines, however, are quite inadequate, the volume of business having increased much more rapidly (about 20 per cent. per annum) than the multiplication of wires and other facilities. It is proposed to expend a large sum ($15,000,000) to remedy this defect, but to secure favorable legislative action in the Japanese Parliament may be a difficult matter at a time when the financial question is a burning one, revenues being less than expenses and the methods of making up the deficit being great political issues. On the other hand, we find that the telegraph service costs only two-thirds as much as the receipts, in spite of the very low rate of 15 sen (7½ cents U. S.), for a message of ten kana (characters) between any two stations in the empire. The address is not charged for, and delivery to any point within one ri (2.4 miles) of the station is also free. To be sure, this is for a short message, since there is an average of two or three kana per word, as will be explained later, but the charge being only one sen (one-half cent) for each additional character, the cost of the Japanese equivalent of a ten-word American telegram would be about 30 sen (15 cents). The Japanese dollar and cent (one yen = 100 sen) are worth almost exactly one-half as much as the corresponding U. S. coins (gold standard), but in giving prices I shall translate directly into U. S. values in every case, to avoid confusion for both writer and reader. The rate for local telegrams is absurdly low: 2½ cents (U. S.) for a ten kana including delivery! This would be about 5 to 8 cents for a ten-word message, which, like the rate for longer distances), is only about one-half as much as corresponding charges in the United States. In the many cases when it is only desired to send a few words, the Japanese rates are not more than a quarter as much as in America, particularly when it is remembered that the same charge applies to distances of five hundred miles or more.

It is certainly evident that the Japanese telegraph system must be operated most economically in order to make 33⅓ per cent. profit at such extremely low rates This result is chiefly due to cheap labor, operators receiving 15 to 25 cents per day, according to their skill. The salaries paid to the higher offices, as well as the wages of linemen and other employees, are all in the same proportion. The cost of materials—wire, insulators, poles, tools, instruments, etc.—are greater than in America, many of them being obtained from there, so that no saving is to be found in these items.

The Morse system is employed almost universally, messages being received both by recorder and sounder. The former is generally used in small country stations and the latter in cities. In the main operating room at Kyoto, there are about ten sounders and ten recorders. These as well as the keys, switchboards, etc., are of European make, and to the American eye clumsy in appearance. Such instruments always carry me back to my earliest electrical studies and the pictures in an old-fashioned "Natural Philosophy." The levers of keys and sounders look as if they were made for a bear trap. Many of the lines are duplexed, and on a few of the most important ones, such as Tokyo-Osaka, the quadruplex is operated. I did not see any printing telegraph apparatus, Wheatstone or other rapid system, and I was informed that they were not used to any extent. As sources of current for main line and local circuits, they have primary batteries at present. But as the consumption of electrical energy for this purpose increases, dynamos and motor-dynamos will soon be required. It is not so many years since an entire floor of the Western Union Building on Broadway was filled with 20,000 cells of gravity battery. This is a good illustration of the fact that Japan is following America and Europe, but she is on the same road, and so far as I have observed, she very seldom loses her way.

The most interesting feature of Japanese telegraphy is its code. This consists of 48 kana, or characters, instead of the 26 letters of the English alphabet. Each character is represented by its own particular combination of dots and dashes, but since there are nearly twice as many characters in the former, it is necessary to make up additional combinations not found in the English code. The Japanese language is written in these kana, each of which is expressed by a certain sound and a certain character. For example, the Japanese word *shima,* meaning island, is composed of the two kana *shi* and *ma* (see table). The telegraph signal for the former is — — . — . and for the latter — . . —, so that the two together — — . — . — . . — signify *shima* (island) when received by a Japanese operator. In a similar manner any word may be expressed in pronunciation or writing by one or more kana, and translating these into dots and dashes we obtain the telegraphic representation. The following partial list of kana will serve to show how they are written, spoken and telegraphed:

Katagana.	Pronunciation.	Telegraphic Signal.
イ	i	— ——
ロ	ro	- — - —
ハ	ha	— - — —
ニ	ni	— - — —
ホ	ho	—— — —
ヘ	he	—
シ	shi	— — - —
マ	ma	—— - - —
ハ	ha	— — — —
パ	pa	— — — — — — — —
バ	ba	— — — — — —

The consonants in the second column are pronounced as in English, but the vowels as in Italian or French In these cases the sounds are short, but some of the other kana have a long sound. It will doubtless surprise many to be told that Japanese is an easy language to pronounce and not difficult to learn for ordinary practical purposes. Without much effort one may also write it by means of the kana, because they are phonetic and free from the horrible irregularities of English spelling. Great difficulty of course arises when one attempts to go more deeply into the language and memorize the thousands of Chinese characters used by educated people.

The 48 fundamental kana may be modified in sound so that they amount to extra kana or elements of language. Take the kana *ha* (see table), and add a little circle, it becomes *pa,* or substituting two little marks for the circle we have *ba.* The second is called "half pure" and the third "impure." In the telegraphic code . . — — . is added to the original kana in the former case and . . in the latter.

Since — . . . is *ha* then — . . . . . is *ba.* For the numerals ten telegraphic signals are used as in the English code. In Japanese writing there is practically no punctuation, consequently the symbols for comma, semicolon, colon, etc., are not required in telegraphy, but characters for full stop, new article and brackets are employed. Many abbreviations, such as *UR* for urgent, *RP* for reply paid, etc., are of course used in Japan as in other countries.

It was stated to me on most excellent authority that telegraphic transmission is more rapid by the Japanese than by the English code: that is to say, a greater amount of information or verbal material can be conveyed in the same time. The explanation of this is to be found in the fact that each kana is equivalent to about two English letters, as may be seen in the short list already given. On the other hand, the average length of one telegraphic kana is somewhat greater than that of one letter in the English code, because there are more of the former, but this does not offset the other advantage. Furthermore the Japanese operators employ no punctuation and, strange to say, do not leave any greater space between words than between kana belonging to the same words; consequently a slight saving in time

is thus effected. The possibility of running the kana along in this way depends upon their definite phonetic character, which prevents the confusion due to the great differences in pronouncing (and often not pronouncing) a certain English letter.

This simplicity of the Japanese language, which gives it the advantage that we should secure by the much-needed "spelling reform" in English, is largely sacrificed by the educated classes, who use Chinese characters in their books, journals, correspondence, etc. This renders it necessary to commit to memory thousands of Chinese hieroglyphics in *addition* to their own kana. Each Chinese character represents a certain word or part of a word, and few human tasks are more severe than learning the required number of them. It is bad enough to have to look at them. Originally they were picture writings, but many parts of speech cannot be represented ideographically, and all of them have been abbreviated or modified in the course of centuries so that they are now almost entirely arbitrary—so many loads upon the memory. To make a very bad matter worse, there are *several different forms* of these characters for use in printing, handwriting, inscriptions, etc., and they for the most part are

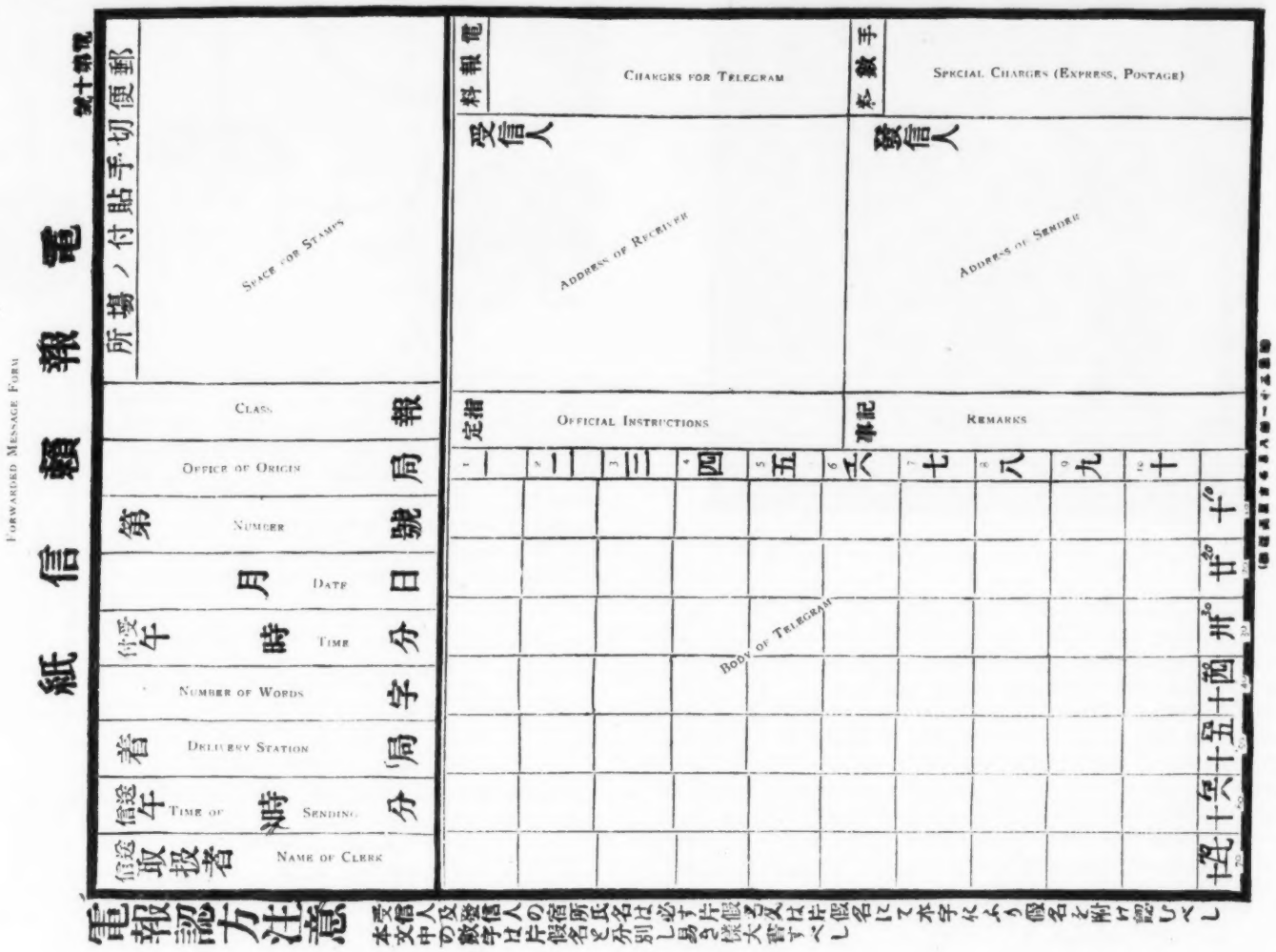


FIG. 1.—JAPANESE TELEGRAPH FORM.

so unlike that each has to be learned separately! Here is ample compensation for being a "foreign devil" and not a "celestial." The Japanese kana were originally derived from Chinese characters, but have been much simplified for facility in writing.

It is interesting to trace the development of the Japanese telegraph code. First, there was the picture writing of the very ancient Chinese, thousands of years before the Christian era. This is usually the primitive form of human records. Second, these pictorial representations were modified in order to make it easier to write them, and to adapt them to different uses; in this way the various Chinese characters were developed. Third, the Japanese kana were derived from Chinese characters corresponding more or less to similar sounds in the two languages. Finally, the kana are translated into the Morse telegraphic code and, strange to say, they are found to lend themselves to it better than the English and other European alphabets. From picture writing to the electric telegraph, four or five thousand years of progress!

An improvement in the Japanese telegraphic code could be made by arranging it so that those kana most frequently used are represented by the shortest telegraphic symbols. This is a very important and successful feature of the Morse code, and was the result of careful study. Unfortunately, the Japanese code was obtained by following the order of the European, and inserting extra combinations of dots and dashes for the characters in excess of twenty-six. The plan on which it was devised will be understood by referring to the portion of the code already given. A rearrangement would effect quite a considerable saving in time by reducing the average length of the telegraphic kana. This would put the Japanese code still further ahead of the European.

The Japanese telegraph form shown in Fig. 1 will be seen to be remarkably complete. For information concerning the telegraph system of Japan I am especially indebted to Mr. D. Aoki, Director of Imperial Posts and Telegraphs at Kyoto, and to Mr. Y. Odani, chief clerk of the Telegraph Section. These gentlemen spared neither time nor trouble in explaining to me the methods employed in their branch of the public service. It is well known that the Japanese are the most polite of all nations, but that is an inadequate statement. If there were some form of meter for measuring courtesy, it would surely prove that the Japanese exhibit several times as much as any other people. This is true of every one, old and young, high and low, officials and private citizens. Their politeness is like the future, it begins immediately and never ends.

Telegraphy in Connecticut.

A bill reported by the Judiciary Committee of the Connecticut Legislature, if passed, practically excludes from occupancy of the highways any outside telegraph company, unless it obtains a state charter. It was reported as a substitute bill, on which no hearing has been had, and indicates the probable success of the Southern New England Company in its contest with the new Boston and New York enterprise. The old company would hardly have favored such a measure unless it felt sure of the Committee on Incorporations, before which the main contest has hitherto been waged and from which the new company is now seeking incorporation. The Judiciary Committee bill does not apply to existing local companies in the state.

Electrical Radiation—II.

By Arthur V. Abbott, C. E.

THE apparatus used by Hertz consisted of a wire circuit, either circular or rectangular in form, about a yard in diameter, to which a Leyden jar, or any other arrangement to provide electrical capacity was attached. When connected to the terminals of an induction coil, sparks passed between the discharging terminals, and this discharge, Professor Hertz reasoned, should set up oscillations in the ether. To detect these oscillations, another similar circuit was ar-

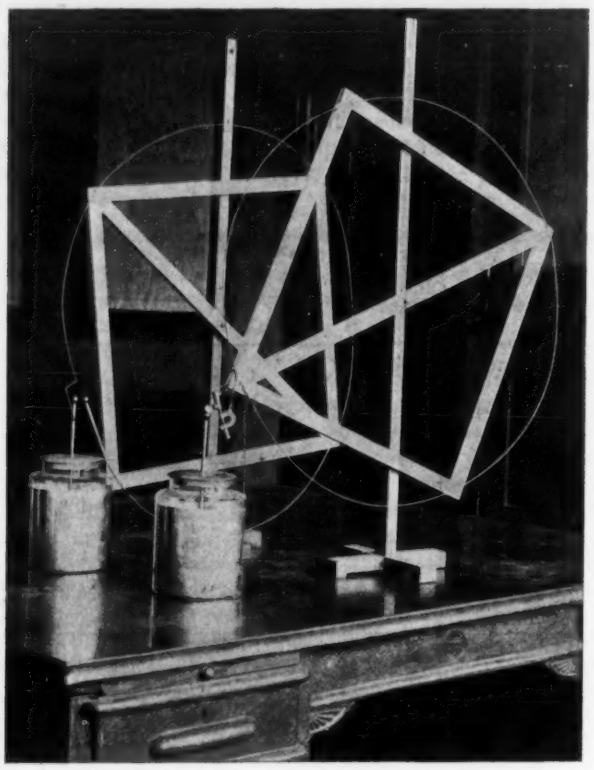


FIG. 1.—APPARATUS FOR THE DETECTION OF OSCILLATIONS.

ranged, provided with a spark gap, so arranged as to be easily adjustable, through very small distances and equipped with a micrometer screw whereby the sparking length could be accurately measured. Such an arrangement is shown in Fig. 1.

Upon starting the induction coil heavy sparks appear between the terminals of the oscillating circuit, and by a careful examination, very minute scintillations may be detected across the terminals of the receiving circuit. As these sparklets are too small to be observed at a distance from the apparatus a galvanometer or electrodynamometer may be placed across the spark gap. On exciting the coil the movement of the spot upon the screen shows the presence of electrical currents in the secondary.

To attain the maximum effects in the secondary circuit it must be very carefully adjusted in its relations to the primary. To this end, the secondary instead of being a complete circle of wire is composed of two semicircles, each of which is prolonged in a horizontal direction. This gap between the two semicircles is bridged by a small piece of wire, which may be moved to and fro, until by experiment the maximum spark length is obtained. In every electrical circuit there are three important properties—capacity, resistance and inductance. The motion of the sliding wire in the preceding experiment varies all of these quantities, and in order that the secondary circuit shall respond, its relations to the primary must be thus carefully adjusted. Denoting the capacity of a circuit by C, the inductance of the circuit by L and the resistance by R, Lord Kelvin shows that if R is $>\sqrt{\frac{4L}{C}}$ the discharge of the condenser dies away regularly with the lapse of time; if $R < \sqrt{\frac{4L}{C}}$ then the discharge gradually expends itself in a series of isochronous oscillations.*

As the inductance and capacity may be varied through an infinite number of forms, the oscillator, as any apparatus for emitting electric waves is called, may assume a corresponding variety of shapes, but as the familiar Leyden jar is always at hand, the evolution of the present most common spherical radiator is easy to trace, as shown in Fig. 2.

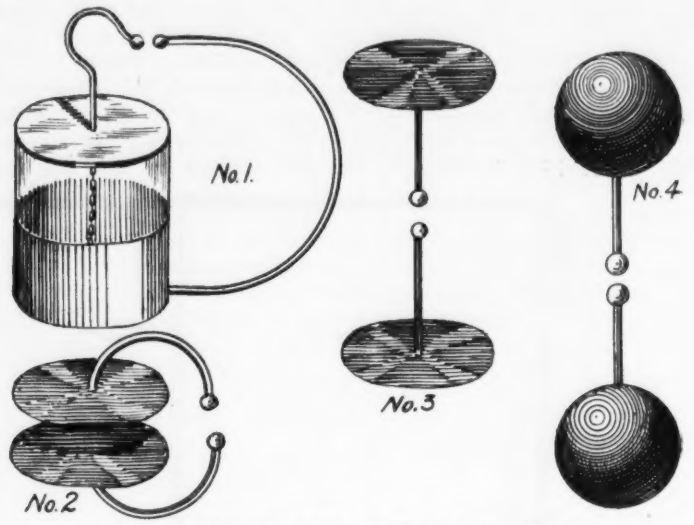


FIG. 2.—EVOLUTION OF THE SPHERICAL RADIATOR.

No. 1 is evidently a jar with a spark gap and wire circuit more or less circular in form. In No. 2 the jar coatings have become a pair of plates separated by an air gap. In No. 3 the circuit is straightened out and the jar coatings are a pair of discs, while in No. 4, the substitution of spheres for the disc is a natural transition to prevent brush discharge.

In Fig. 3, eight of the most common forms of oscillators are represented diagrammatically. No. 1 is a pair of straight rods terminating in knobs, separated by a short spark gap. To increase capacity

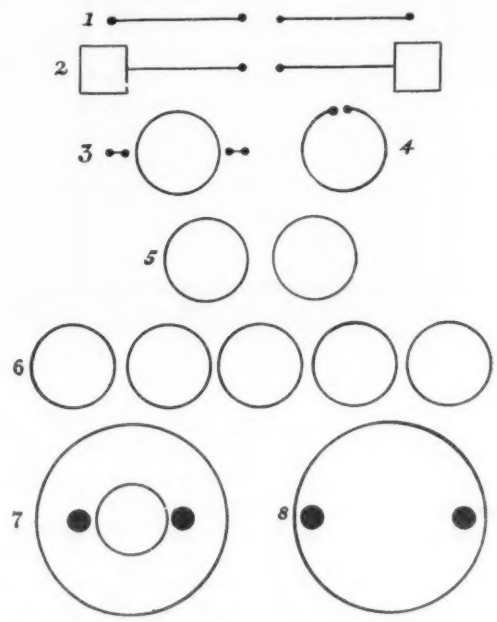


FIG. 3.—COMMON FORMS OF OSCILLATORS.

in No. 2 a pair of plates are added to the terminii of the rods. In No. 4, the rods are bent into a ring. No. 3 is a simple sphere sparked to at either end of a diameter. No. 5 is composed of two equal spheres, the spark gap placed on a line through their diameters. In No. 6 a number of spheres are used, to produce proportionately greater intensity. While the spherical radiator is exceedingly convenient, it is so dead beat as only to give two or three waves. Its vi-

* The periodic time is given by the following formula:

$$T = \frac{2\pi}{\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}}$$ See Lecons sur L'Electricite, par E. Gerard, p. 256.

If R is very small in comparison to the other quantities, as is usually the case in pieces of apparatus designed to emit electric waves. $T = 2\pi\sqrt{LC}$. Now as T may be varied by changing either one, or both factors, a very wide range of vibration may be secured and knowing the periodic time and rate of propagation of the wave, the wave length is easily found as the quotient of these quantities.

brations may be prolonged at the sacrifice of intensity by enclosing it in a metal cylinder as shown in No. 7. A similar device is shown in No. 8, composed of a metal cylinder enclosing two spark knobs set on a diameter. For convenience, the formulæ for the wave length emitted by each of these forms are given in a foot note.*

As electric oscillations only accompany a disruptive discharge the more sudden and violent the spark the greater is the proportion of energy converted into radiation, therefore the adjustment of the spark gap is of vital importance in the construction of an oscillator. All parts of the apparatus should be carefully rounded, to prevent any approach to brush discharge, and the surfaces of the gap should have as large a radius as possible. These surfaces must also be maintained in the highest state of polish, particularly if short waves are desired, for even a few minutes sparking will so roughen the metal as to prevent the emission of the shortest oscillations. To minimize the labor of repolishing it is convenient to make the terminals of adjustable cups, in which polished spheres may be placed, continually revolved, so as to present fresh surfaces for the emission of sparks. The immersion of the terminals in oil has also been tried with good success, as it largely contributes to the efficiency, permanency and suddenness of the spark action. The length of the spark is another important and very essential consideration, but one which requires adjustment for every different arrangement of oscillator and receiver. A gap either too long or too short will fail. Usually only from one-half centimeter to three centimeters in length is fairly successful. The observer soon learns to judge from the character of the spark as to the working of the oscillator. A thin faintly luminous violet spark gives poor results and indicates too small capacity in the apparatus. A thick heavy perfectly straight white spark is equally bad, denoting an excess of capacity, while the most efficient spark is jagged and arched and plays about the discharge surfaces. It appears to have a reddish violet centre and to be surrounded with several concentric sheaths of flame. With each reversal of the coil current, the spark is suddenly extinguished with a loud snapping sound, and is also very sensitive to a magnet.

A consideration of the formulæ applying to oscillators would seemingly lead to the conclusion that the possible combinations of L, C and R are so great as to permit of evoking an infinite series of waves and that the whole conceivable range of vibratory energy lies open to examination. The Hertzian discovery has, indeed, given an entirely new field for exploration, the confines of which extend almost beyond the range of scientific imagination, but as yet little exploration has been made. With ordinary apparatus, ranges of vibration are easily secured, that vary from a couple thousand miles in length to a little less than three inches, but beyond these rates the limitations of physical apparatus are at present insuperable. In Table III. a rough arrangement of electrical waves, as we now know them, is given.

TABLE III. WAVES IN THE ETHER. SPEED OF ELECTROMAGNETIC WAVES, 186,000 MILES PER SECOND.

Designation.	Wave length.	Number of vibrations per second.
Magnetic waves from the sun.....	1¼ millions miles	1 in 6½ seconds.
Flash of lightning.....	11,000 miles	17
Induction coil.....	18 miles	10,000
Pint Leyden jar.....	54 ft.	18 millions.
Large oscillator.....	1 ft.	100 "
Five-inch oscillator.....	7 in.	172 "
Shortest electrical wave.....	2½ in.	480 "

While the long waves indicated in the upper portion of the table are capable of producing most stupendous effects and of exciting disturbances the influence of which may be felt even beyond the bounds of the solar system, it is the shorter vibrations that are studied most intently, and the upper ranges of electrical radiation seem more likely to be of immediate value. The shortest pulsations are about three inches in length, while a wave of red light is roughly, three one hundred thousandths of an inch, hence the shortest electrical wave is at least a hundred thousand times as long as a light wave. Everyone is aware of the frightful inefficiency of present illuminating methods, for even with the most efficient form of electric arc, the illumination returns are but a fraction of a per cent. of the fuel energy expended. If, with an oscillator, a charge of electricity could be set vibrating upon a sphere so small as to emit waves of the dimensions of light, illumination could be obtained without heat and without loss, but a sphere of this size approximates to what we suppose to be the dimensions of the ultimate atoms, so if we can ever discover a method whereby we can oscillate the electrical charges of the atoms, the problem of illumination will be solved.

The Kansas Telegraph Suits.

Reference was made in these columns last week to the institution of several suits in Kansas against the Western Union Telegraph Company for alleged violation of the new telegraph rate law. District Attorney Judge Hazen, at Topeka, on May 8, decided that the multiplicity of suits brought against the company was vexatious and oppressive, and that the telegraph company had a cause of action in applying for an injunction. Five hundred and forty-two damage cases have been filed before one justice of the peace. Judge Hazen said it would take three years to try all of them.

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* Let l = length of the rods over all, inducing spark gap; d = the diameter of the rods; and D = the distance between their centres.

No. 1. Two straight rods.

$$L = 2l\left(\log_e \frac{4l}{d} - .75\right) \text{ in electromagnetic C. G. S. units.}$$

$$C = \frac{l\,d}{4\,D\,v^2} \text{ in electromagnetic C. G. S. units, when v is the velocity of light,}$$

$$T = 2\pi\sqrt{2\,l\left(\log_e \frac{4\,l}{d} - .75\right)\frac{l\,d}{4\,D\,v^2}}$$

If λ = the wave length then $\lambda = v\,T$.

Approximately between the ranges of l = 10 cm. and l = 200 cm. and d = .2 cm and d = 5 cm.

$$\lambda = 15\sqrt{l\,d}.$$

In all cases l is supposed to be relatively large in respect to d.

No. 2.—Rods with two equal square plates.

Let l = the distance between the plates, including the spark gap; d = the diameter of the rods = a = the side of one plate, then

$$L = 2\,l\left(\log_e \frac{4\,l}{d} - .75\right) + 2\,a\left(\log_e \frac{(l+a)^2}{\left(\frac{d}{2}\right)^2} + .5\right)$$

$$C = \frac{\frac{\pi\,d\,l}{2}}{2\,\pi\,l\,v^2} + \frac{a^2}{2\,\pi\,v\,2\,(l+a)}$$

Multiplying and reducing approximately

$$\lambda = 2\,\pi\sqrt{2.5\,d\,(l+a) + \frac{a^2\,(a+l)}{2\,\pi\,(a+l)}}$$

No. 3—Simple sphere diametrical spark gap.

Let D = the diameter of the sphere, l = the sum of the length of both conductors, on each side of the sphere which form the spark gap; and d the diameter of these conductors, then

$$L = 2\,l\left(\log_e \frac{4\,l}{d} - .75\right)$$

$$C = \frac{D}{2}$$

$$\lambda = 2\,\pi\sqrt{D\,l\left(\log_e \frac{4\,l}{d} - .75\right)}$$

If l and d are very small in proportion to D, then this reduces approximately to

$$\lambda = 1.3\,D.$$

No. 4. A plane ring.

Let R = the radius of the ring and d = the diameter of the rod of which it is made; then

$$L = 4\,\pi\,R\left(\log_e \frac{8\,R}{d} - 2\right)$$

$$C = \frac{\pi\,d}{2}$$

and approximately

$$\lambda = 4\,\pi^2\sqrt{2\,R\,d}$$

No. 5. Two Equal Spheres.

Let D = the diameter of the spheres, and l the distance between their centres; then

$$L = 2\,D\left(\log_e \frac{l^2}{\frac{D^2}{4}} + .5\right)$$

$$C = \frac{R}{2}$$

$$\lambda = 2\,\pi\sqrt{\frac{D^2}{2}\left(\log_e \frac{l^2}{\frac{D^2}{4}} + .5\right)}$$

and approximately

$$\lambda = 7\,D.$$

The remainder of the oscillators given are merely modifications of the preceding cases.

Annual Exhibition of the French Society of Physics.

BY PAUL RENAUD.

AT the annual exposition of the French Society of Physics, held in Paris in the middle of April, 1899, the two subjects uppermost were wireless telegraphy and Röntgen rays. The theory of wireless telegraphy was cleverly illustrated by an apparatus of Branly, which showed the little value of the theories thus far prepared for explaining the working of coherers under the influence of Hertzian radiations. It consists simply of a pile of metallic discs (of bismuth, aluminium, etc.), the two ends of which are connected in one circuit with a cell, a bell and a key. When the key closes, the current does not flow, but if in the neighborhood Hertzian radiations are produced, the pile of discs acts as a coherer and gives passage to a current, which operates the bell. It is only necessary to give a light tap on this column or pile to interrupt the current. The present theories of the coherer can hardly be considered sufficient for explaining this action.

Wireless telegraphy was more *practically* illustrated by M. Ducretet, who had installed two complete posts 90 feet apart, the receiving post being provided with a complete automatic registering apparatus. There were also shown Morse records obtained by the same operator in experiments on wireless telegraphy in and over the City of Paris for a distance exceeding four miles. We are now permitted to say that M. Ducretet will shortly experiment at sea over distances exceeding 35 miles.

The special feature of the Ducretet apparatus (Fig. 3) consists in a completely automatic receiver; that is, a Morse registering apparatus, starting by itself under the action of the electric waves from the transmitter. In this latter is used a rotary interrupter, the principle of which is not new, but the details have been carefully studied for this special application. The motor transmits a reciprocating movement to a copper rod plunging in a mercury mass, having a very small surface (Fig. 1) to avoid the undulations so often experienced in interrupters of this kind. The oscillator is fed from an ordinary induction coil, the balls not being separated by any viscous medium. The transmitting l ey is shown in Fig. 2.

The same constructor has experimented with a modification of the Wehnelt interrupter, which has given him excellent results, but has not yet been put in commercial form. The most original modification of the Wehnelt interrupter to be seen in this exposition is the Wehnelt-Carpentier. Its remarkable advantage is in permitting the use of a low voltage current, given by a few cells. It results from experiments by M. H. Armagnat that the minimum necessary voltage for obtaining the phenomenon is a function of the temperature of the acidulated water—the higher its temperature, the lower the necessary voltage, in the type of interrupter referred to, the liquid is previously heated to 80 or 100 degrees by an external source of heat—afterwards this source is unnecessary to keep the interrupter in good operating condition, as the heat generated in its mass is sufficient to compensate for the losses due to radiation. Moreover, radiation is carefully avoided by means of a double envelope of thermo-insulating material.

In order that the inconvenience of acid vapors be avoided, the apparatus is enclosed, and the generated gases are discharged in an alcoholic preparation. Last, but not least of its advantages, is that the active part of platinum wire can be so regulated that the apparatus is easily applied to all conditions, which depend, as is well known, on the coil itself, on the source of current, the temperature, the length of spark to obtain, etc. Many failures have already been experienced from want of this close regulation.

An interesting exhibit was one by Prof. André Blondel, of his oscillograph, universal wattmeter, and regenerable coherers. The former are too well known for mention here, the merits of the first named apparatus having been well illustrated recently by Prof. Blondel's celebrated experiments on alternating arcs. The coherers seem to be superior to other types, both in sensibility and practicability. The filings, *a a*, are made of alloys of oxidizable with non-oxidizable metals (silver with nickel or copper), and a very great sensitiveness can be obtained by the careful proportioning of the parts. Moreover, the quantity of filings can be conveniently regulated by means of the bulb attached to the upper tube. This type of coherer is shown in Fig. 4; *b b'* represent the amalgam paste; which solidifies at the end of several hours, and *D D'* are stoppers, making joint with the paste.

In radiography, one of the most interesting exhibits was presented by M. Chabaud. This constructor brought out a new tube permitting the direct use of alterating currents for radiography. One electrode offers a small surface of emission, and the other a very large one. During the period when the low resistance electrode is used as a cathode, the waves flow freely, and when as an anode, the current is interrupted. This electrode is practically the only cathode of the tube of 2 mm diameter and extending to centre of the bulb.

FIGS. 1, 2 AND 3.—DUCRETET INTERRUPTER, MERCURY KEY AND WIRELESS TELEGRAPH RECEIVER.

Some very interesting experiments by M. Villard illustrated the action of Röntgen rays and ordinary light on sensitive plates of silver gelatino bromide, the experiments being intended to give indications as to the nature of Röntgen rays, (Fig. 5). The ordinary light suppresses the cloud produced by such rays on a sensitive plate, so that M. Villard has been able, by saturating a plate with the rays, and furthermore, by photographing a lighted object, to obtain directly a positive print. The plate so saturated with rays is panchromatic—that is, equally sensitive to the different colors—and this gives the print thus obtained a more striking resemblance to nature than ordinary prints. A mention must be made of the osmo-

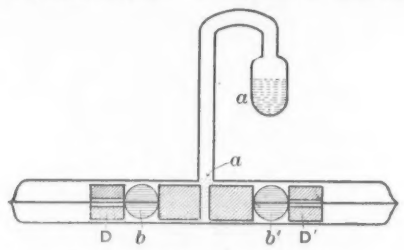


FIG. 4.—BLONDEL'S COHERER.

regulator invented by the same physicist for the purpose of permitting the simple regulation of the vacuum in Crookes tubes, without recourse to the mercury pump.

A platinum tube 1½ mm diameter, the outside end of which is closed, is embedded at the other end in the bulb of the Crookes tube. If after a period of operation the vacuum of the tube increases, it is sufficient to heat the outside end of the platinum tube with an alchool lamp or other hydrogenic flame; the platinum by osmotic properties acquired at this high temperature gives passage to hydrogen, which penetrates inside the tube.

If, on the contrary, we wish to "pump" hydrogen out of the tube, it is sufficient to heat the outside of the platinum tube when cov-

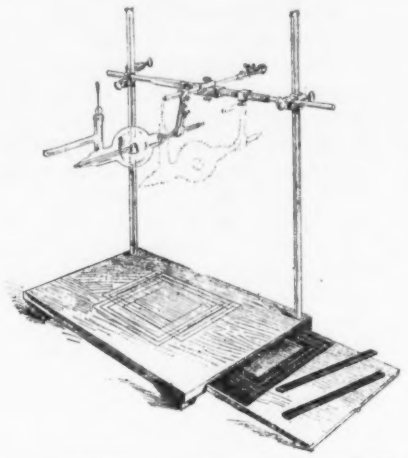


FIG. 5.—ROENTGEN RAY PRINTING ARRANGEMENT.

ered by a sleeve protecting it from the hydrogen. The same section contained stereoscopic apparatus for the examination of negative and positive proofs.

Among the induction coils used in connection with the transmitters one only offers a few features of interest, known as Rochefort and Wydt's traansformer. It gives a spark of from 8 to 10 mm with three storage batteries. The current taken is from three to four amperes, the total energy being about 20 watts, five or six times less than the energy required by ordinary Rhumkorf coils for the same effect. The remarkable results obtained with this transformer are probably due to the employment of a long core, and short secondary coils in the section of maximum flux and having a large capacity. There is also probably resonant effect.

CURRENT NEWS AND NOTES.

THE AGE OF THE MAGNET.—According to Prof. Ewing, it is stated that a Chinese navigator, Hoang Ti, piloted a fleet of vessels with the aid of a floating fragment of lodestone, a natural magnet, as early as twenty-four centuries before Christ. It is also stated that Marco Polo, a Venetian, first brought a mariner's compass from China to Europe in the thirteenth century.

BOILER AND FURNACE EFFICIENCY.—In a paper read before the Washington meeting of the American Society of Mechanical Engineers, Mr. R. S. Hale said that present knowledge enables the efficiency of a boiler to be predicted reasonably well, provided the efficiency of combustion and the air supply are accurately known; and although these quantities themselves cannot yet be accuraately predicted, nevertheless tests have shown that the temperature of the furnace is at least one factor in the question of good combustion and that the rate of burning per square foot of grate affects the air supply. The most pressing need, he considers, in the study of boiler efficiency is the further determination of the factors that govern the efficiency of combustion and the air supply. The latter can be studied by analyzing specimens of gas at the bridge wall for different methods of frequency of firing, thickness of fire, etc.

OFFICE BUILDING ISOLATED PLANTS.—In a paper entitled "The Equipment of Tall Office Buildings in New York City," read by Reginald P. Bolton at the Washington meeting of the Society of Mechanical Engineers, it is stated that the central station is the most serious competitor with respect to independent electrical plants for office buildings. At present users of large quantities of current can obtain a rate as low as 4 cents per electrical horse-power hour on a use of 10,000-hp hours per annum, with a still further reduction of one-half-cent if a storage battery be adopted. As to the cost of generating current by an independent plant, it is stated that the cost of a horse-power hour for power, oil and repairs may be, with economical aarrangements, as low aas 2.4 cents, a fair figure inclusive of interest and depreciation being 2.8 cents. If one-half the share of all engineer labor is added, which is stated to be more than its due, a final figure of 3.8 cents is reached.

A MARCONI PATENT.—An American patent was issued on May 9 to Marconi on an improvement relating to his apparatus for wireless telegraphy. It was found that when both a receiver and recorder were employed on the same station, the Branly tube was liable to injury from its close proximity to the spark coil transmitter. In order to obviate this objection, an arrangement is patented whereby all of the receiving apparatus except the recorder is enclosed in a metal box having only a small opening in it. One terminal of the sensitive relay in the Branly tube circuit is grounded on the inside of the box, and one terminal of the exterior recorder similarly connected to the outside of the box, the box itself being grounded on the same earth plate as the transmitter. The ends of the wires from the other terminal of the relay and recorder, respectively, are peculiarly connected, a coil being interposed outside the box, consisting of 120 turns of about No. 27 B. & S. rubber insulated wire covered with tin foil, the foil being electrically connected with the iron box. This coil, it is stated, prevents oscillations of the transmitter from reaching, through the relay terminal, the coherer at the same station. The ærial conductor, which need not be insulated, can be connected, by means of spring contacts, either to one of the induction-coil spark balls for transmitting, or to one end of the Branly tube for receiving. An arrangement is shown in which the aerial conductor is connected to one terminal of the primary of an induction coil, the other terminal being grounded on the box; the secondary of the induction coil is in series in the Branly tube circuit, and the coil and tube are shunted by a condenser circuit.

ELECTRICAL PROTECTION OF SAFES AND VAULTS.—In a paper read before the Chicago Electrical Association on May 5, Mr. Clyde J. Coleman gave a description of the various means in use for the electrical protection of safes. These systems he divided into open and closed circuit systems, the former of which is but little used except in residences, where, it is remarked, it has proved more of a nuisance than an advantage. The commercial system of electrical protection are all based on the closed circuit. Among the means mentioned for protecting premises are cementing narrow tinfoil strips on the inner surfaces of window glass so that any breakage or fracture of the glass will open the circuit; the use of glass tubes filled with mercury and connected in circuit, or tubes filled with water or compressed air, or the maintenance of a vacuum in a partition or enclosure, any disturbance from an abnormal condition resulting in an electric alarm being given. A good method is the use of wires kept under a definite state of tension by a spring,, any increase or diminution of which allowing an arm to touch a contact point, thereby sounding an alarm. It is stated that the Bank of France lowers its vaults each night in a pit filled with water which connects electrical float devices so that in case it should be drained an alarm would be given. In the discussion which followed Mr. Cravath described the Coleman system of electrical protection which consists of an "electrical lining" for the vault composed of layers of tinfoil so interconnected that any attempt to break through will cause a disturbance in the circuit by the open circuiting or short circuiting of some of the tinfoil layers. A current of .002 ampere is kept constantly flowing in the vault lining, and a variation of 15 per cent. above or below this amount will sound an alarm. In reply to questions by members as to the use of electricity in perforating safes, it was stated that a five-ply chrome steel safe 3½ inches thick was pierced with a current of 120 amperes and 80 volts at the arc, in 20 minutes; with 175 amperes in 16 minutes, and with 300 amperes in 3 minutes. A five-ply safe of the same material 7½ inches thick was burned through by 300 amperes in 25 minutes. A 3½-inch Corliss was burned through by 400 amperes in 1½ minutes. Holes were burned through a solid block of vault steel 12 inches thick in 26 minutes with 350 amperes, and in 15 minutes with 500 amperes.

GUGLIELMO MARCONI, of wireless telegraphy fame, was, according to the Lond. *Electrician*, born at Griffone, near Bologna, Italy, on April 25, 1874, and is therefore only 25 years of age. His experiments in England were begun in July, 1896, but when he first arrived there with his apparatus the custom house authorities mistook the instruments for bombs or infernal machines, and destroyed them.

SCIENTIFIC SCHOOL FOR THE UNIVERSITY OF BIRMINGHAM.—Mr. Joseph Chamberlain, Colonial Secretary and Chancellor of the University of Birmingham, England, according to a London despatch, has received an offer from Mr. Andrew Carnegie to bestow $250,000 upon that institution provided the scientific school be made its principal department. Mr. Carnegie points out the great need in England of young experts in industrial science, and refers to Cornell University as an example in this particular.

WIRELESS TELEGRAPHY IN PARIS.—In the Bulletin of the French Société d'Encouragement is an account of the experiments of M. Ducretet in wireless telegraphy in and about Paris. On Nov. 7 signals were sent between the Eiffel tower and the Pantheon, a distance of about 2½ miles. Between these two stations there is a great number of large buildings, but the signals received, even during a rainstorm or in a thick fog, were always very sharp. A 10-inch induction coil was used. M. Ducretet has constructed an automatic recording receiver to register the intermittent atmospheric disturbances produced during storms. In one case 311 atmospheric discharges were registered during a storm lasting one hour and ten minutes. The discharges, it is stated, were registered before the appearance of the lightning and the thunder clap.

ARC LAMP CARBONS.—A patent was granted May 9 to Anton Othmar Simonnier, of Vienna, Austria, on a composition for arc-light carbons, consisting of finely ground wood charcoal or carbon from gas retorts, or both, mixed with finely ground quartz and diamond dust. The mixture is made up into a dough by incorporating it with a solution of copper salt and with jellied salicic acid, the pencils being molded from this in the ordinary way and afterwards burned, as usual. The proportion of ingredients by weight are: Carbon, 83 parts; quartz, 7 parts; diamond dust, 10 parts. To 20 parts of the thoroughly mingled powder are added about one quart of a concentrated aqueous solution of copper sulphate, and one quart of jellied salicic acid. The inventor claims that carbons made in this manner burn much more slowly than those in present use.

A NEW STORAGE BATTERY.—A patent was granted May 9 to Henry Blumenberg, Jr., of New York, for a storage battery, in which use is made of an electrolytic solution containing a sulphate of metal which, it is claimed, will prevent the injury heretofore resulting to the plates of the lead and zinc battery by the presence in the electrolytic solution of an uncombined acid radical. An electrolytic liquid is employed containing bisulphate of potassium, sodium or ammoniam, in combination with tersulphate of aluminum. It is stated that with zinc and lead plates, a double sulphate of zinc is formed while the battery is discharging, while in charging the zinc is deposited on the zinc pole and the lead is peroxidized, the two actions being in reverse to each other; also, that the greater the proportion of sulphate salt in the electrolytic liquid, the less will be the resistance of the secondary battery, and vice versa. The inventor says he finds that after the water has taken up as much of the tersulphate of aluminum as possible, it will also take up the bisulphate of potassium, sodium or ammoniam, thereby reducing the resistance of the battery and lessening the risk of injury to the positive and negative plates.

ELECTRIC ELEVATORS.—At the Washington meeting of the American Society of Mechanical Engineers Mr. Charles R. Pratt read a paper entitled "Elevators," in which is given a complete description of the mechanical features of the Sprague elevator, including the earliest types. The electrical portion of the subject was considered by Mr. G. H. Hill in the same paper. A valuable property of electric elevators was referred to whereby a very small increase in speed over the normal caused by the driving load, will create a counter e. m. f. at the motor above that of the power circuit, and cause it to generate current back into the line, thus acting as a dynamic brake. A variation in speed of less than 10 per cent. is obtained with the best machines for a variation of load from a maximum positive power of the machine to a similar negative load. Where a number of electric elevators are connected together, this action produces a remarkable saving in total power required. An instance is cited where twenty-three machines, nearly all of the same size, were installed at one point, the average hoisting current for each machine at 23 volts being about 50 amperes. Owing to the motor generating current back into the line when an elevator is descending, the power required to operate the entire plant averages but 10 amperes for each elevator in service, and the total current supply is very constant.

THEORY OF WIRELESS TELEGRAPHY.—Prof. Blondel, in a paper read before a French scientific association, asserts that it is no longer possible to look upon wireless telegraphy as Hertzian waves radiating from the spark gap of a transmitter, since Marconi has shown that the range is enormously increased by means of earth connection and the application of a vertical conductor. The vertical conductor and the earth play the part of two plates of a condenser which is charged by the coil and becomes the seat of an oscillating current when the spark passes across the air gap. The displacement currents produced by the oscillating e. m. f.s are concentrated in a limited space around the vertical conductor, but the Hertzian waves produced by them around the conductor spread straight out into space. Oscillations in the wire are thus not in themselves utilized, but they give rise to others which create a disturbance in the surrounding ether. The role of the vertical conductor is twofold. In the first place, it regulates the intensity of the centre of disturbance by augmenting the volume of ether disturbed. These disturbances are in the form of hemi-spherical sheets diverging from different points of the vertical conductor and abutting normally on the ground. The higher the conductor the greater is the pulsating sphere, the greater is the volume of the ether disturbed and the greater is the distance at which the disturbance is perceptible. In the second place, the vertical conductor directs the magnetic lines of force in the direction calculated to produce the maximum effect on the parallel conductor at the receiving station. The magnetic lines of force are horizontal circles concentric with the conductor and expand horizontally into space till they strike the receiving conductor at right angles and generate oscillations which affect the coherer at its base.

TELEPHONE PATENTS.—On May 9 two patents were granted to James H. Spencer, of New York, on telephone transmitters, and on the same day a patent was granted to Daniel Therrell, of Atlanta, Ga., for a telephone relay and repeater system. One of the Spencer patents is on a heavy diaphragm of rubber or similar material with slightly dished faces, and secured to the transmitter frame by two diametrically opposite clamps curved to bear at two points only. Bolted to the middle of the diaphragm is a button, opposite to which is a second button carried by the transmitter frame, the opposing faces of the two buttons being in microphonic contact. The other Spencer patent is on a diaphragm consisting of two or more thin disks with tissue interposed, and clamped between two rings of hard non-conducting material, such as wood fibre, having a lining of cork or cloth on the faces engaging the diaphragm. In the center of the diaphragm is clamped a button opposite to which is a second button carried by the frame of the transmitter; the opposing faces of the buttons are grooved concentrically, the portions between the grooves being polished to form alternate rough and polished surfaces. The buttons are covered by a cylindrical wrapper of carbonized flexible material, such as a clock, having alternate slits for breaking or interrupting the current. The Therrell patent relates to a system, the object of which is, first, to increase the power of the transmitter in a repeating system, and thus enable it to reach over greater distances; and second, to provide a repeater capable of multiplying in power the original voice-currents. The secondary circuit of the transmitter spoken to, divides equally between two circuits, in each of which circuits is an electro-magnet, having for its armature the diaphragm or a microphone carbon transmitter; in circuit with the latter is a local battery and the primary of an induction coil, the secondary of which coil connects to the main line. A duplicate arrangement is in the other part of the divided circuit. The line may have a relay station to renew the strength of the voice-current, the arrangement there being similar in principle, but more complicated, than that at the transmitting end of the line, just described.

TELEPHONE RIGHTS IN MEXICO.—Information from the City of Mexico is to the effect that President Diaz has refused to grant a charter to a long-distance telephone company on the ground that the service would injure the business of the Mexican telegraph system. At a meeting of the stockholders of the Mexican Telephone Company, which was held in New York City a few days ago, it was voted to endeavor to secure the rights to use the telephone not only in Mexico, but between the United States and Mexico.

A NICARAGUAN POWER CONCESSION.—The government of Nicaragua, according to a despatch from Managua, has granted to Herbert Savage, of Saginaw, Mich., the right to utilize as much of the waters of the River Tipitape as may be needed to operate an electric power plant. The river, which connects Lakes Nicaragua and Managua, has a fall of about 16 feet. The concession is, however, subject to the previous rights granted to the Maritime Canal Company. It is proposed to furnish electric light and power for the cities of Managua, Grenada and Masaya. The concession gives Mr. Savage the right to elevate the water in Lake Managua about 8 feet by the erection of a dam across Rio Tipitape.

THE TRANSPORTATION OF A BUSY PEOPLE.—Under the above caption Mr. William J. Hammer has an interesting article in the *Independent* of May 11, giving many data relating to the urban and suburban transportation of passengers. Referring to electricity on elevated railways, Mr. Frank J. Sprague is quoted as saying that it is perfectly practicable to increase the present schedule of the Nek York elevated railway 35 per cent. and at the same time effect a saving of 3 cents per car-mile. Mr. Hammer expresses the belief that in a comparatively short time we shall be able, through the introduction of electricity and the perfection of the roadbed, to travel with perfect ease and comfort at a speed of 125 to 150 miles an hour, and ultimately considerably higher. In the article are described the latest advances in electri: traction, including the Sprague system now in operation in Chicago, the Chicago & Milwaukee three-phase line and the several Swiss three-phase mountain roads.

AN ELECTRIC PROPHET.—We have received a communication in which the writer says he can show that waves of electricity are the cause of business prosperity or depression. He modestly disclaims being as yet perfect in his capacity of prophet, but adds that when George Stephenson got his first railway train moving and Prof. Morse sent his first message, they still had something to learn. The only justification for the claims made are the statement: "From years of study and observation, I am satisfied that the different waves of electricity have different effects on men's minds. When one wave comes along it depresses the mind and causes a drop in the market, while when a different wave arrives it gives him courage and the results is a rise in prices." He says that the great wave of electricity that has been with us for two years lifting up the price of stocks, passed away last February, and that consequently the market will be an average one for the rest of the year. The letter gives a forecast of the market based upon the electric wave theory. For example, on May 16 the electric condition will be such that between 1:30 and 2 P. M. stocks will fall rapidly. On May 24 the market will rise until noon, remain doubtful for a little while, and then fall. The writer claims that on the electric-wave hypothesis he was able to anticipate the government crop report which was issued May 11, and after carefully looking over the situation he finds that the crop report to be issued on June 11 will be favorable. He parenthetically adds that on that day so many waves of electricity will be present that their great friction will cause a rain.

EXPORTS OF ELECTRICAL MATERIAL FROM THE PORT OF NEW YORK.—The following exports of electrical material were made from the port of New York for the week ending May 9: Argentine Republic, 113 packages electrical material $3256; Antwerp, 42 packages electrical material $1592; British East Indies, 18 cases electrical material $491; British Guiana, 4 packages electrical material $300; Brazil, 34 packages electrical material $1351, 17 cases electrical machinery $1195; Bordeaux, 9 cases electrical material $100; British West Indies, 168 packages electrical material $4526; Bremen, 5 cases electrical n aterial $250; British Possessions in Africa, 112 packages electrical material $2626, 1 case electrical material $6; Cuba, 43 packages electrical material $573, 13 cases electrodes $7500, 2 cases electrical machinery $107; Central America, 11 packages electrical material $380; Chili, 29 packages electrical material $1358; Ecuador, 9 packages electrical material $347; Florence, 4 cases electrical material $967; Fiume, 3 cases electrical machinery $306; Glasgow, 1 case electrical material $298; Havre, 28 cases electric motors $4940, 71 cases electrical machinery $2679, 145 cases electrical material $11,434; Hull, 13 cases electrical material $650; Hamburg, 89 packages electrical material $9198; Helsingfors, 2 cases electrical material $15; London, 94 packages electrical material $1751, 22 cases electrical machinery $1490; Liverpool, 10 packages electrical material $520; Lisbon, 7 cases electrical material $215; Mexico, 4 cases electrical material $42; Marseilles, 106 packages electrical material $17,213; Newfoundland, 3 cases electrical material $69; Peru, 15 packages electrical material $566; Roane, 8 cases electrical material $431; U. S. of Colombia, 142 packages electrical material $4819.

THE GREATER AMERICA EXPOSITION.—The Greater America Exposition which will be held in Omaha, Neb., beginning on July 1 of this year, covers the same ground and utilizes the same buildings that were occupied in 1898 by the Trans-Mississippi Exposition Company. The electrical display will be far in advance of that of last year. There will be one-third more light along the Midway, and on several buildings the results of the electricians' work are to be seen. Arrangements are being made for illumination on a much grander scale than that of last year. Chief Electrician Henry W. Rustin, who had charge of the electrical work last year, states that the scheme for the lighting of this year's exposition contemplates the use of one-third more lights than at the Trans-Mississippi Exposition. The bulk of the increase will be on the Bluffs Tract, which will be made as much of a feature in this line as was the Grand Court a year ago. Over 3,000 lights will be placed on the Architectural Building alone, which was last year outlined by less than 600 lights. The same prodigality of illumination will be applied all over the Tract and the Midway. A number of new lights will also be placed on the Grand Court, as a result of last year's experience, to effect a better and more pleasing illumination. The details of each building will be brought out to better advantage than they were last year. In order to provide for the 12,000 additional lights, arrangements have been made with the Thomson-Houston Light Company in the city to furnish current for the arc lights on the ground and the power required to operate the exhibits in the buildings and the machinery of the amusement features of the Midway. Last year all of the current was generated on the exposition grounds, but since much more will be required this year, it has been necessary to go outside for the additional supply.

THE FRANCHISE TAX BILL.—Representatives of corporations throughout New York state aff cted by the Ford corporation franchise tax bill, which was passed during the closing hours of the last legislature, appeared last week before Governor Roosevelt at Albany and urged him either to veto the measure or call a special session of the legislature to amend the bill, or postpone its operation until next year. Those who appeared in opposition to the bill, and the interests represented by them, are as follows: David B. Hill, the Elmira, Penn Yan, Corning and Hornellsville Street Railroad Company; Wilson S. Bissell, Buffalo General Electric Company, Buffalo and Niagara Falls Electric Light and Power Company, and the Cataract Power and Conduit Company; Charles J. Bissell, the Rochester railroad companies; C. L. Allen and William P. Goodelle, the Syracuse and Auburn railway and light corporations; W. Caryl Ely, John C. Milburn and Porter Norton, the Buffalo and Niagara Falls railway companies; George P. Curtiss and J. P. Eckert, the Binghamton street railway companies; C. Tracy Rogers, of Binghamton, president of the Street Railway Association of the State; Edward Lauterbach and William C. Truell, of the Third Avenue Railroad Company; M. M. Fenner, the Fredonia and Dunkirk Railroad Company; D. F. Van Vleet, the Ithaca Street Railroad Company; J. W. McNamara, the Albany Street Railway Company; G. B. Story, the Hoosick Falls and Bennington Railway; C. Cleminshaw and William Shaw, the Troy Railroad Company, and Francis B. Thurber, of New York City. Ex-Senator Hill made the principal argument in opposition to the bill. He contended that the scheme for taxation as outlined in the bill constituted a radical departure from well-established principles and confused the distinctions which have nearly always existed between essentially different kinds of property, and that it establishes a dangerous and unsatisfactory system of assessment. His clients did not object to the taxation of franchises, but to the particular method proposed by the bill.

LETTERS TO THE EDITORS.

The Value of Electric Brakes as Recuperating Devices for Automobiles.

To the Editors of Electrical World and Engineer:

Sirs—In regard to the exception taken by Mr. Henry in the issue of April 9 to the figures submitted by me under the above caption, it seems wholly a misconception of the different conditions pertaining in the case of motor vehicles and street cars.

A draw bar pull of 18 pounds per ton is, I believe, not far from the generally accepted figure used in street car practice under good roadbed conditions, and this would permit, so far as the physical possibility is concerned, of doing what Mr. Henry mentions respecting the 15-ton car on a 6 per cent. grade. But this is a case of iron wheels on steel rails.

Quite different is the road vehicle with its rubber tires on all kinds of pavement, good, bad, and frequently none at all, and it is only natural that a much greater level draw bar pull should be required; 50 pounds per ton, the figure assumed for a 2000-lb. pneumatic-tired carriage, is sanctioned by actual measurement, being, if anything, a low average figure, for it was obtained upon a hard macadam pavement, Rankine's formula for steel rails and iron wheels has no place here, and it can readily be seen how the ratio of the power required on a 10 per cent. grade to the power on a level may be one-third of what it is with the street cars, and how recuperating brakes upon the two vehicles would differ in the percentage of power which could be returned.

It is to be noted that in the case of the motor carriage, not only is this device at a disadvantage, as compared with the street car, through the large portion of the gravity component which is balanced by the frictional resistance of the tires in descending grades, but the power must be stored in batteries under conditions which give but little more than 65 per cent. efficiency.

HARTFORD, CONN. THOMAS B. BOOTH.

Railway Return Feeder System.

To the Editors of Electrical World and Engineer:

Sirs—Permit me to correct a statement of Mr. J. H. Vail, made in his communication in your issue of April 29—that he obtained a broad patent on the insulated return feeder system for electric railways. Patent No. 508,615 of Nov. 14, 1893, granted to me, shows and claims substantially the following arrangement. "An insulated return conductor connected at intervals to the track rails."

Mr. Vail is deserving of much credit in attacking the electrolytic problem in his thorough engineering way at an early date, and although his solution is in line with the later and best yet proposed, and the cost is much less than water pipes, I fear it will not come into use until forced by municipal authorities.

It seems rather strange that the largest railway corporations allow transmission losses that the smallest electric light companies would not tolerate for a day, but such is the case.

In attempting to sell "Resistance Detectors" I have been able to feel the pulse, and find that large percentages of electric railway engineers have never got their wits to work on the problem. For instance, the voltmeter is usually the only instrument used to test track bonds; guesses made in the office are about as scientific and reliable, as the voltmeter fluctuates with the current in the rail, which is an unknown quantity. Another and more practicable way practiced on more than one road in the West with which I am familiar, is to occasionally station a man on the rear of the car, and when he sees a flash his duty is to drop off, hunt for a piece of fence wire and "fix" the joint. Still another method used on a big paying Eastern road was related to me by its president as follows:

"We watch the joints after after a rain storm, and those that dry off quickly are rebonded."

That such roads can keep out of the receivers hands and carry passengers at a cent or less per mile when the steam roads charge three cents, is suggestive of the great possibilities of electric traction.

JOHN C. HENRY.

DENVER, COL.

Phase Angle Measurement.

To the Editors of Electrical World and Engineer:

Sirs—To emphasize the practical importance of an instrument which will at all times indicate the condition of alternating current circuits as regards lag or lead between e. m. f.'s and currents, and furthermore to illustrate the results of ignorance of these conditions, I may cite the case of a lighting and railway plant located in a Southern state, which I recently had occasion to examine.

In this plant, a 300-hp synchronous three-phase motor replaced three steam engines as prime mover for driving eight small generators supplying direct-current circuits with lighting energy and motive power.

The alternating motor was supplied, through a step-down transformer station, with current generated at a water power fourteen miles distant. The daily load factor of the generators in the local station was about 25 per cent., and the average motor load about the same proportion of its capacity. A Shallenberger integrating wattmeter was installed upon one leg of the circuit supplying the motor. Exciting current was furnished by a 3-kw 110-volt generator and had been customarily kept constant throughout the day at about 18 or 19 amperes. The power bills had averaged about $21 per day for supplying this motor, and did not appear to vary materially with variations in the duty required of the motor. The bills were calculated directly from the meter readings.

The station efficiency, from the motor terminals to the distributing switchboards, where all output was measured by Thomson integrating wattmeters, averaged about 30 per cent. for the all-day runs. This very low efficiency and extremely high power bills (in view of the cost per kw-hour and the station output) indicated wrong conditions somewhere and was further confirmed by the unsatisfactory regulation of the alternating circuit potentials.

An immediate experiment with reduced exciting current showed the cause of the trouble, and resulted in a reduction of fully one-half in the average bills for power. The meter had never told the truth since it started, as to the power consumed by the motor, but the charges had been made upon its indications, and had cost the consumer probably fifteen hundred dollars excess within ten months.

Evidently, therefore, lagging and leading currents are serious matters when their presence is unknown or disregarded. It is true that, at present, precise adjustment for minimum working currents cannot be maintained where the loads are continually and rapidly fluctuating (though there is reason to believe that this may be automatically accomplished in the near future), and such adjustment is not always desirable; but it is apparent that even approximate adjustment for average variations of load may in many cases be of the greatest value, as in the foregoing, where the inductance factor of the motor, aided by an unsuitable meter, resulted in doubling the power bills.

C. R. MCKAY.

NEW YORK, N. Y.

Two-Phase Versus Three-Phase Systems.

To the Editors of Electrical World and Engineer:

Sirs—The difference of opinion which appears still to exist concerning the relative merits of the two-phase and three phase systems seems to me to be due to the fact that the partisans of the two-phase system employ, in order to prove the superiority of that system, arguments which apply to the four-phase system.

The two-phase is in itself a non-symmetrical system, and consequently cannot well lay claim to any of the properties of polyphase systems, properly so-called. It is nothing else than, so to say, a double single-phase system. If by the employment of a common-return conductor it permits an economy in copper to be obtained, the generators of low voltage and two-phase transformers—that is, transformers with a common magnetic return—are subject in practice to unsymmetrical effects from mutual induction which modify the phase relation between the two currents, rendering it sensibly different from a quarter of a period. In addition, the voltage on the two circuits becomes unbalanced when the load increases. The only means whereby these effects can be avoided is either to employ two single-phase systems with the machines and transformers absolutely distinct, the former being mechanically coupled in a manner to obtain a phase difference of a quarter of a period (Stanley system); or to employ the four-phase system, properly so-called. But is this lat-

ter system preferable to the three-phase? I think not, and the reason will be apparent when we consider the different generating, transmitting and receiving parts which constitute a polyphase transmission system.

Generators.—It is generally held that a given armature core can be utilized more advantageously with four-phase (or two-phase for high voltages) than with three-phase currents. This cannot be disputed in the case of machines of high tension, having four to six slots per pair of poles; but it is not true when the number of teeth or slots per pair of poles is a multiple of 6 or 8. In this case the same armature, wound delta or star, will have—theoretically be it understood—for the same current and same flux in the air gap, capacities that are in the ratio of 2 to 2.6. In practice, four-phase or three-phase generators are of identically the same capacity, have the same drop and cost sensibly the same.

There remains the question of the effect of differences of load on the three circuits. These differences only arise from electric lighting loads; if these are small with respect to the total power utilized, three-phase transformers can be employed, the secondary circuits of which are disposed, as I have elsewhere indicated,* in such a manner that the energy in the primary circuit is the same whatever the difference of load on the secondary circuit. These transformers have, it is true, a specific capacity 40 per cent. less than that of ordinary three-phase transformers, for which reason their use is not recommended in cases where the energy employed for lighting is a large proportion of the total capacity. In the latter case, whatever may be the system—four-phase on three-phase—it is necessary to employ generators having a small drop, so that the machines will regulate closely.

From the foregoing it appears that three-phase generators are in no manner inferior to four-phase generators.

The Line.—The advantage with respect to the line of the three-phase system being the only superiority which is not contested, does not need to be here considered.

Transformers.—The use of single-phase transformers does not appear to be necessary in most cases, whether the system be four-phase or three-phase.

The advantage of the four-phase system is in requiring but two transformers of half the power, instead of three of third the power. In any case, it is but fair to remark that the first cost which results become less proportionately as the capacity of the apparatus becomes more considerable. Are we not therefore justified in believing that this disadvantage of the three-phase system is of relatively small importance?

Motors.—I will not here re-argue the case of two-phase versus three-phase synchronous motors, but merely recall the fact that these motors are sensibly the same in specific capacity. While the three-phase motor has for a given intensity of rotary field a maximum couple somewhat larger than two-phase motors, the stability of the latter is somewhat greater; and while, if the slip of the three-phase motor is very slightly superior and consequently the armature efficiency slightly inferior to that of two-phase motors, the maximum power factor is sensibly the same.

Rotary Converters.—We finally reach the main bone of contention between the partisans of the two or four-phase systems—the superiority of rotary converters of this system. It cannot be doubted that rotary converters of two or four-phases may, for the same heating of the armature, give a greater capacity at the commutator than the same machine utilized as a three-phase converter, but it is none the less true that it is possible, as has been shown, and as Mr. Kapp in his interesting paper on rotary converters recalls, to supply a rotary converter with six-phase currents by means of a three-phase transformer; the three secondary circuits of which are not internally interconnected. The superiority of rotary converters thus supplied, consequently becomes as indisputable as the superiority of four-phase converters over three-phase converters, and the increase of capacity which results is easy to determine, as below.

I have recently established, by generalizing the formula given by Mr. Kapp for the losses in a three-phase rotary converter having a power factor equal to unity, that the expression for the loss in a rotary converter of n phases, and having a power factor eqral to $\cos\ \phi$ is as follows:

$$P = 2\pi r I^2 \left(1 + \frac{a}{2} - \frac{4 n a}{\pi^2} \cos \phi\right)$$

where I is half the value of the direct-current output, $2\pi r$, the total resistance of the armature, and a a coefficient, having the value,

$$a = \frac{2\sqrt{2}}{k \cos \varphi}$$

k being the so-called Kapp coefficient, and having the theoretical value (for a field following the sine law),

$$k = \frac{n \sin \frac{\pi}{n}}{\sqrt{2}}$$

In applying this formula to the case of rotary converters of three, four or six phases, we obtain the capacity expressed as a percentage of the capacity of the same armature mechanically driven generating a direct-current with the same heating.

COMPARISON OF TYPES OF ROTARY CONVERTERS.

Type of Rotary Converter.	Cos φ	Ratio of Output of Rotary to that of Same Machine Used as a Generator, Assuming a Sinusoidal Field	Ratio of Output with Given Ratios of Pole Width to Pole Pitch.	
			⅔	½
Three-phase	1	1.34	1.38	1.44
	0.9	1.09	1.13	1.21
	0.8	.90	.95	1.02
Two or Four-phase....	1	1.64	1.67	1.70
	0.9	1.28	1.34	1.38
	0.8	1.03	1.09	1.25
Six-phase	1	1.96	1.98	1.99
	0.9	1.44	1.49	1.13
	0.8	1.14	1.20	1.26

These results have reference to the theoretical case of a sine field, and where the ratio of the width of a pole and the distance between two neighboring poles is ⅔ or ½. For these ratios k has the value

$$k = \frac{1.06\, n \sin \frac{\pi}{n}}{\sqrt{2}} \quad \text{and} \quad k = \frac{1.16\, n \sin \frac{\pi}{n}}{\sqrt{2}}$$

The preceding figures show that the six-phase rotary converter has, when compared with the four-phase converter, the same superiority with respect to specific capacity that the latter has over the three-phase converter.

In conclusion, I am convinced that, aside from some entirely special applications, the employment of the three-phase system is, whether from the point of view of first cost, regulation or reliabiliity of operation, more advantageous than the four-phase system, or the so-called two-phase system which conceals itself behind the last mentioned.

C. F. GUILBERT.

PARIS, FRANCE.

*See *L'Eclairage Electrique*, tome XIII., page 486, 1897.

Measurement of Insulation Resistance.

To the Editors of Electrical World and Engineer:

Sirs—I have read with considerable interest the editorial in your paper of May 13 on "The Measurement of Insulation Resistance," and wish to say that, from practical experience in designing instruments for this class of measurement, I heartily agree with your conclusions.

For sometime past it has been the custom on the part of large consumers of insulated wire, to insist that the manufacturer meet a required insulation test at the voltage to be employed on the line, such a test being usually made with an alternating current on account of the ease of transformation. For this class of work, my company has at times been called on to design instruments for a total voltage of as high as 40,000 volts, the method of use being to connect one terminal of the voltmeter to the inside of the vat in which the wire is being tested, while the other terminal is attached by means of a plate to the outside of the insulation.

In addition to such tests at the factory, it is, of course, essential that the central station superintendant should be able, from time to time, to measure the insulation resistance of his lines, and while a great many of them still adhere to the galvanometer and bridge method, the more progressive have adopted the plan you suggest, of using a voltmeter, for such measurements.

For a number of years past, my company has designed and manufactured instruments for this class of work under the general title of ground detectors, these instruments being essentially voltmeters. For direct-current work we advocate the use of a central zero voltmeter, the two outside binding posts being connected to opposite sides of the line, while the central binding post is connected to ground. This instrument has a scale marked in degrees and is sup-

plied with a chart which gives the value of the deflections directly in volts and, by equating these values with the line potential and resistance of the instrument, it is very easy to figure the absolute ohmic resistance between line and ground.

For alternating current work we have designed an instrument which is essentially an alternating current voltmeter connected to the secondary of a transformer. This transformer is designed to reduce from the line voltage to a convenient voltage of say 100 volts at the instrument. One terminal of the primary of the transformer can be connected to either side of the line by means of a two-way switch the other terminal being connected directly to ground. Such an instrument permits the exact measurement of the insulation between line and earth. Of course, it is perfectly feasible to omit the transformer provided sufficient resistance is incorporated in the instrument to permit it to be placed directly from line to ground. For constant-current arc-light service we employ a rather more elaborate instrument, which, however, performs precisely the same functions as our constant-potential ground detector.

The advantage of using this class of instrument for insulation measurements will, I think, be apparent to any practical man if he gives the subject a little consideration. In the first place, the instrument costs less than a bridge and galvanometer set and is very much easier to handle. In addition to this, measurements can be made while the line is operating under working conditions with the normal potential difference existing between line and ground. I have frequently seen cases in which series arc systems carrying a pressure of about 6000 volts would indicate infinite resistance between line and earth when they were tested by means of a bridge and galvanometer, which lines would show a dangerously low insulation resistance under operative conditions. There is, of course, a vast difference between measurements taken by means of primary cells in which a few volts difference of potential exists, and measurements taken when the potential difference reaches several thousand volts.

It is also perfectly possible, by the voltmeter method, to locate the grounded point, or the point where insulation is weak, quite as accurately as can be done by any bridge and galvanometer method, provided the drop per unit length of line is known. Beyond this there is no danger of injuring the voltmeter if it has been properly designed to withstand the total line voltage. Very truly yours,

J. FRANKLIN STEVENS.

PHILADELPHIA, PA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Doubling the Voltage of Dynamos.—In a brief discussion of the methods of re-winding a dynamo to give double its former voltage, it is stated in a short article in the Lond. *Elec. Eng.*, April 28, that the re-winding of the field magnets may be dispensed with by exciting the magnets from a third brush placed between the other two, an arrangement which was recently patented by Sayers and described in the Digest some time ago. The third brush is of carbon and is placed about midway between the two main brushes, the shunt winding being connected between the extra brush and the main brush ahead of it in the direction of rotation. This arrangement is said to be free from all the objections to separate excitation and it has the useful property of giving the machine an almost level characteristic, for as the load increases the main brushes are shifted forward while the third brush remains fixed, thus increasing the voltage across the shunt. A somewhat unexpected result is that the small auxiliary brush gives no trouble by sparking and is found to work satisfactorily. —Lond. *Elec. Eng.*, April 28.

Quickly Made Coils.—The *St. R'y Jour.*, May, publishes a short communication from J. F. Hobart, on drying shellac. He states that to quickly bake the shellac on an electric coil it can be ignited and at just the right time—decided by experience—the fire put out. The shellac must not be burned, but just enough of the alcohol should be removed to make the shellac hard and brittle. The method is recommended by the writer for emergency use.—*St. R'y Jour.*, May.

REFERENCES.

Theory of Non-Synchronous Motors.—The beginning of an article in which he defines the characteristic qualities in non-synchronous motors which are represented in the graphical diagrams, and develops convenient practical formulas for calculating such motors with the necessary degree of accuracy. For multiphase motors he uses the Heyland diagram and for the single phase motors he develops a diagram from this one.—Heubach. *Elek. Zeit.*, April 27.

Polyphase Electrical Apparatus.—A long illustrated article of an elementary nature.—Pool. *Power,* May.

LIGHTS AND LIGHTING.

Selection of Incandescent Lamps.—In a short article in *Cassier's Mag.*, May, by Mr. Adams, he discusses the subject of the efficiency and life of incandescent lamps and shows how important it is to make a proper selection based on the energy and life, and the cost of energy and lamps. He deduces some curves and a table from the results of the tests made by Prof. Thomas in 1892. The tables give the percentage of initial candle power, initial watts, and initial watts per candle for these curves, corresponding to each 100 hours of life from 1 to 1200. The costs of lighting can be greatly varied by the proper selection of lamps and the object of the paper is to show this. He claims that the average candle power during the whole life is of little or no importance, as a more powerful light than is required at one time, does not compensate for less light than what is required at another, on the contrary it makes the poorer light more unsatisfactory. For any given location the minimum light should be decided upon and the lamps should then be furnished to give not less than this amount during their life for the least amount of money, considering both the cost of power and that of the lamps. As is well known, a more efficient lamp has a shorter life and it should be decided whether the saving in power for a lamp burned out before it reached the minimum will compensate for the more frequent renewals of a less efficient lamp. He constructs a diagram giving the candle power and cost at various stages of the life of a 16-cp 56 watt lamp, a 16-cp 50 watt lamp, and a 10-cp 35 watt lamp. The conclusions arrived at could be applied to other candle powers and efficiences. The costs of the lamps are taken as 20 cents each and that of the power as 10 cents per kw hour. He shows that it would be cheaper to use the 50 watt 16-cp lamp even though it burned out every 400 hours on the average; the main argument against this lamp is that it burns out quicker than the 56 watt lamp, but as it will certainly burn more than 400 hours on the average, that argument has no force and the 50 watt lamp should at least be used in all cases where 10 to 16 cp is required, unless the cost of the energy is much lower than 10 cents per kw hour. Where 9 candles are sufficient, he shows that it would cost 20 per cent. more to use the 16-cp lamps than the 10-cp, renewing the first at the end of every 1000 hours and the latter every 200 hours. For power rates greater than 10 cents the advantages pointed out for the high efficiency lamps are increased, while for very low power costs as in some isolated plants, these advantages are diminished. For any other costs, curves of the same kind can be readily constructed to show the most economical efficiency and lamp life. A proper selection by the above methods for a large plant, is claimed will ensure a considerable early saving even where energy is cheap, and a large saving where the usual rates are charged. Adams. *Cassier's Mag.*, May.

Maxim Lamps.—A short note in the Lond. *Lightning,* April 27, states that the new factory for making these lamps at the rate of 6000 per day is being completed. In appearance these lamps are like those in common use, but there is claimed to be a saving of 25 per cent. in the number of watts required; in fact, this efficiency which was claimed some time ago, has even been slightly improved upon. The average ordinary lamp after it has been in use for some time, requires about 4 watts per candle and up to about 4.5 watts; the Maxim lamp will require only 2.8 to 3.0 watts per candle without any sacrifice of the life; nor is it seriously affected by slight fluctua-

tions of energy. The works will soon be in operation and will have the largest capacity of any in England. Further descriptions of the works are promised in a subsequent issue.—Lond. *Lightning*, April 27.

TRACTION.

General Situation of Electric Railways in Germany.—The *Int. Ed.* of the *St. R'y Jour.*, for May, publishes a general review of the German electric railway field by a German writer. Electric power was first introduced into Germany by von Siemens in 1879, and in 1881 Siemens built a railway at Lichterfelde 2.3 km in length. The development of the trolley system dates from the industrial exposition at Bremen in 1890, where a full working plant on the American system was exhibited. During the first period of the introduction of the trolley railways, American products, such as motors, controllers, insulators, etc., were used exclusively, but later the German manufacturers took hold of these branches with the best of success. There are now five principal companies supplying electric railway apparatus in Germany, three in Berlin, one in Nuremburg, and one in Dresden. To these have been added recently another in Frankfort and one in Cologne. Each company has associated with it banking firms which assist in financing the securities of the tramway companies equipped. The manufacturing companies make most of the apparatus used in electric railway construction and also do a large export business. The principal rails used are the Phoenix and Haarmann and Thomas steel is used for this purpose. Car bodies are also manufactured in Germany, and one firm in Hamburg built 550 cars during 1898. The limitation in the width of the cars prevents the employment of cross seats so popular in America. Engines are built up to 3000-hp in Germany, and vertical engines are the most popular type. Storage batteries are also employed very extensively both in connection with the power stations and also on the cars in the mixed trolley and accumulator system. In the equipment of tramways, orders are not really open to free competition as the tramways are usually financed by companies called Gesellschaften für electrische Unternemungen, associated with the electrical manufacturing companies, and while this makes the first cost high, it insures a well equipped plant. There have been a few high speed electric railways built, notably one between Düsseldorf and Crefeld. It is thought that there is a large opening for German manufacturers outside of Germany, especially in Russia, Austria, Hungary, China, Japan and South America, and that German products can compete successfully with those of other countries.—*St. R'y Jour.*, May, *Int. Ed.*

Expense of Mechanical Traction in Paris.—The *St. R'y Jour.* for May publishes a digest of the report of the Compagnie Generale des Omnibus, of Paris, so far as it relates to the expense of operation of mechanical motors. The car km. run by the different systems of the line of this company during 1898 were as follows: Compressed air locomotives, 546,198; Serpollet motors, 902,968; compressed air motor cars, 640,375; Rowan, 117,684. To this should also be added one line operated by both Rowan and compressed air locomotives, 354,297 car km. The cost of operating compressed air motor cars each drawing one trail car amounted in 1898 to 0.4815 francs per car km., and for compressed air locomotives capable of drawing several trail cars, 0.5358 francs per car km. The tables of operating costs are given; the first shows the operating expenses for all mechanical power cars, and the second and third tables the expenses made up on the same basis, for horse cars and omnibuses. (See also Digest, April 29.)—*St. R'y Jour.*, May.

Electric Railways in Paris.—The *St. R'y Jour.*, May, describes briefly the electric railway situation in Paris. There are three companies operating electric railways in Paris and its environs; one has 55 accumulator motor cars, 28 motor cars for mixed trolley and accumulator service and 5 trolley cars. The second has 20 motor cars and the Claret-Vuilleumier surface contact system is used. The third has 17 motor cars and a mixed trolley and underground conduit system. Views of all of these three roads are given, as are also some on the Raincy and Montfermiel trolley road near Paris. A statement then follows of the equipment of all of the Parisian tramway companies.—*St. R'y Jour.*, May.

Large Interurban Electric Railway in Southwest Missouri.—The *St. R'y Jour.* for May publishes a short description, with a map, of the Southwest Missouri Electric Railway Co. This line is 35 miles in length and connects five towns, with a total population of about 60,000. There are two power stations, with boosters. The voltage on the generators is 600 and it is raised to 800 on the boosters. The trolley wire is No. 0. Considerable difficulty has been found in preventing the trolley wheel from jumping from the wire at high speeds. The only remedy is in careful construction and attention to the trolley rope by conductors while passing around curves. The company operates an express and way service; the cars on the latter make an average speed of twenty miles per hour, including stops. The road is a single track line, with turnouts, and cars are dispatched by telephones. The fares charged average about one cent per mile.—*St. R'y Jour.*, May.

Electric Railway and Lighting Plant at Czernowitz, Austria.—Mr. Ziffer, in the *Int. Ed.* of the *St. R'y Jour.*, May, describes a small line at Czernowitz 6.7 km in length. Power is taken from the local electric lighting station. The gauge is 1 m. and the grades are as high as 10 per cent. The rails weigh 33.5 kg. per m. The trolley wire is divided into insulated sections and the cross sections of the feeders supplying each section are made proportionate to their length, so that the voltage is the same under normal conditions on the different sections of the trolley wire. The span wires are connected for the most part to cast-iron rosettes attached to the house walls; these rosettes are fitted with rubber washers to reduce noise and vibration of the span wire. There are eight cars, each fitted with two 20-hp motors.—*St. R'y Jour.*, May, *Int. Ed.*

Public Automobiles in Paris.—A description is given in *L'Ind. Elec.*, April 25, of the vehicles and charging station to be introduced in Paris; a dozen of these vehicles were started the beginning of April, at present there are 30 in use and in three months there will be 100; the capacity of the station is but 1000 carriages, and in several years it is expected that there will be 4000 in use. The batteries may be changed at the station in three minutes; each charge is enough for a run of 50 to 60-km (30 to 36 miles); the changes are to be made every afternoon and evening. External views of two carriages are given, as are also views of those in New York, for facilitating a comparison. The data for the carriages are given; the total weight with passengers is about 5000 pounds of which the useful weight is only 12.1 per cent.; no particular accumulators are used, as the company is prepared to try all the different kinds, but the carriages now in use are provided with what in this country are known as the chloride accumulators; with 44 cells, weighing 750-kg, the capacity is 135 ampere hours, at a rate of 30 amperes, and corresponds to a run of 30 to 36 miles; the positive plates are of the Planté type and the negatives of the chloride type. A single four-pole motor is used with a double field and armature winding and two commutators; it weighs 96-kg, is of an American type and develops 3000 watts at a speed of 1500. The batteries are always connected in series and the changes in the speed are obtained by the series-parallel coupling; there are four speeds, 3, 6, 14 and 17-km per hour. Steering is done by means of a worm with a reduction of 1 to 52; accurate steering is therefore possible, but very rapid handling is required for short curves.—*L'Ind. Elec.*, April 25.

Overhead Line Construction.—Mr. Herrick, in the *St. R'y Jour.*, May, compares wooden and iron poles, and gives the life of iron poles as 33 years, and the average life of wooden poles as 11 years. Iron poles should be painted once in six years. For wooden poles, chestnut, hard pine or cedar are generally used; the essential features of a good wooden pole are described, and the chief defects are stated and illustrated.—Herrick. *St. R'y Jour,,* May.

Safety Device for Steam Railroad Crossings.—The *St. R'y Jour.*, May, describes a safety device for use on crossings with steam railroad companies, recommended by the electrical expert of the New York State Railroad Commission and adopted on a number of crossings in Buffalo. A brass trough is carried over the trolley wire and sustained in place by span wires. The trough is connected to the trolley wire so that if the latter should break, the trolley wheel will press against the trough and obtain current to carry the car past the crossing. The method of constructing and suspending the trough is illustrated.—*St. R'y Jour.*, May.

A Method of increasing the Life of Gears and Trolley Wheels.—The *St. R'y Jour.*, May, publishes a letter from John C. Henry, stating that in his early electric railway work he used trolley wheels made of steel and found them very satisfactory and most desirable. He also lubricated his motor gears with a mixture made of bar soap and oil. It seemed to create on the face of the gear teeth a thin scale which prevented the metal from wearing.—Henry. *St. R'y Jour.*, May.

REFERENCES.

Surface Contact System.—A long, well illustrated description of the system of the Union Company is given by Mr. Kubierschky in the *Elek. Zeit.*, April 27. The system is that of the General Electric Company of this country, with which that German company is

affiliated. The article states that in Europe there are in use at present only two surface contact systems, that of Claret and Wuilleurmier in Paris, and that of the Thomson-Houston Company at Monaco and Monte Carlo, besides the Diatto system in Tours (see Digest this week). The Schuckert system was tried in Europe, but several horses were killed due to the fact that some of the contacts remained after the car had passed.—*Elek. Zeit.*, April 27.

Traction Auxiliaries.—The beginning of an article, the present portion of which is entirely on trucks, containing illustrations showing the development, chiefly in America. At present the trucks have been developed so that a 35 ft. car body can be carried on a single truck with a 7 ft. rigid base. A few remarks are made on the relative advantages of the service with single truck cars as compared with double trucks, trailers being used in the former case during the hours of great traffic.—Cottrell. Lond. *Elec. Rev.*, April 28.

Railway Statistics for Europe.—A reprint of the table noticed in the Digest April 8.—*St. R'y. Jour.*, May.

Electrical Inspection of Street Car Equipments.—A reprint of the lecture which was noticed in the Digest, March 18.—Herrick. *Jour. of Frank. Inst.*, May.

Electricity on Main Line Railways.—An abstract of the article noticed in the Digest, Feb. 25 and March 11.—Feldmann. *Eng. Mag.*, May.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Station Practice in Great Britain.—A short article in which the author discusses the general principles which promise substantial reductions in the cost of electricity in the near future. Among the details which reduce the cost of supply, he discusses the three-wire system, high-speed engines, and 220-volt lamps. He believes high-speed engines to be cheaper in the long run. He considers it to be to a large extent fallacious to argue that combinations of traction and lighting plants will solve the difficulty of the load factor; the light load should be made an adjunct to the power load and not the primary object; a competent and absolutely independent consulting engineer should be employed; attention is called to the impossibility of separating the first cost and working costs; he advocates large central stations in favorable districts supplying electricity in bulk to distributing stations situated near the centre of supply.—Hall. *Eng. Mag.*, May.

REFERENCES.

Bootle.—The conclusion of the long, well illustrated description of this station noticed in the Digest last week.—Lond. *Elec. Eng.*, April 28.

An illustrated description is also published in the Lond. *Elec.* and *Elec. Rev.*, April 28, and *Lightning*, April 27.

Direct and Alternating Current Distribution.—The beginning of a reprint of a student's paper read before the Institution. He discusses the relative merits of the two sytems and endeavors to show which one it is best to use under different circumstances.—Williams. Lond. *Elec. Rev.*, April 26.

ELECTRO-PHYSICS AND MAGNETISM.

Coherer.—A brief description of Blondel's new coherer is given in the Lond. *Elec. Rev.*, April 28. He considers the Marconi coherer better than others, but believes the present one is in some respects superior to it. He found that the metallic particles should form a thin layer of oxide on their surfaces, the thickness of the layer being of great importance, as it will not work well if too thick or too thin. Instead of using mixtures of metals he gets better results with alloys which should contain an oxidizable metal and an non-oxidizable one, the proportions being such as to give the required degree of saturation. The best results were obtained with alloys of silver with nickel or copper like those in the American or Swiss nickel coins. He also uses a side tube or pocket which contains a reserve amount of the filings, so that when those in use become fatigued, the tube may be shaken and the filings thus replaced by fresh ones.—Lond. *Elec. Rev.*, April 28.

Damp Coherers.—Aschkinass noticed that an elementary copper coherer showed differences according to the dielectric or electrolyte surrounding it, and describes a curious anti-coherer in the *Wied. Ann.*, a brief abstract of which is given in the Lond. *Elec.*, April 28. He used two pointed wires, just touching each other, and found that in air or methyl alcohol the ordinary coherer action sets in, but when the points are in water the action will reverse, the resistance increasing by the impact of electric waves, returning to the previous value when the waves cease. The same action takes place when the points are connected by a drop of water. The action of these reverse coherers seem to be yet unexplained.—Aschkinass. *Weid. Ann.* No. 4, abstracted in Lond. *Elec.*, April 28.

Visual Representation of Alternating Currents.—A simple method of visually representing alternating currents, as for instance in a three-phase circuit or when there is phase shifting, is described with illustrations by Mr. Weber in the *Elek. Zeit.*, April 27. It consists essentially of a disc on which is drawn the polar diagram of one complete sine wave, the space between that curve and the circle representing the zero line, being colored black. This black space resembles two crescents, with their points together, one slightly smaller than the other. This diagram is laid off by drawing a circle for the zero line, and laying off from it as a base line, the successive values of the current on radial lines instead of vertical lines as usual, the positive currents being laid off on the outside of the zero line circle and the negative currents on the inside. This disc is then revolved around another which contains radial slits through which those black fields are visible. For a three-phase current for instance there would be three radial slots at 120° from each other; when the former disc is revolved, black lines varying in length and in proportion to the currents will be visible through these slots. By using different colored lines, both current and voltages may be represented simultaneously, or currents of different phases may be shown. —Weber. *Elek. Zeit.*, April 27.

REFERENCES.

Theory of the Discharge.—The beginning of a mathematical article in which he develops a more complete theory of the phenomenon of discharge, including the case in which the capacity, the resistance and the self-induction vary continuously during the discharge itself. The usual theory in which the relations are given which show whether the discharge will be oscillating or continuous, applies only to the case in which the capacity, resistance and self-induction are invariable quantities.—Petrovitch. *L'Eclairage Elec.*, April 27.

Orthocathodic Rays.—An abstract of a communication to the Italian Academy on the simultaneous emission of orthocathodic rays by the two electrodes and on the property of the violet light in Crooke's tubes.—Sandrucci. *L'Eclairage Elec.*, April 22.

Conductivity and Viscosity.—An abstract of an article by Dennhart in the *Wied. Ann.* 67, p. 325, on the electric conductivity and viscosity of aqueous solutions of salts.—*L'Eclairage Elec.*, April 22.

Earth's Magnetism.—The values of the constants at Madagascar and those for Roumania at the beginning of 1895 are given in *L'Eclairage Elec.*, April 22.

Magnetic Induction.—A brief abstract of a Physical Society mathematical paper on the effect of a solid conducting sphere in a varying magnetic field on the magnetic induction at a point outside.—Whitehead. Lond. *Elec. Rev.*, April 28.

Magnetism.—The beginning of a reprint of a James Forest lecture; the present portion is chiefly historical and is very interesting reading.—Ewing. Lond. *Elec. Eng.*, April 28.

French Physical Society.—A continuation of the description of the exhibits noticed in the Digest last week.—*L'Eclairage Elec.*, April 22.

ELECTRO-CHEMISTRY AND BATTERIES.

Pescetto Accumulator.—An illustration of the grid of this accumulator (see Digest last week), with some brief information, but taken from a paper read a number of years ago, is given in the Lond. *Elec. Rev.*, April 28. The grid is of the ordinary kind with square holes but the cross bars are cut into in a slanting direction with a knife, and the little prongs thus made are bent sideways over the holes, thus holding the active material in the meshes. The superiority claimed for the battery is thought to be mainly due to the physical condition of the active material which is produced by mixing with the oxides a substance called ulmate of ulmin, obtained by boiling sugar in dilute sulphuric acid. This material, which has a brown color, is gradually eliminated from the active material partly because it is slowly soluble and partly by subsequent oxidation; the gradual elimination leaves the active material in a porous condition. Lond. *Elec. Rev.*, April 28.

Everard Accumulator.—A brief description, with an illustration of a plate and a discharge curve, is given in the Lond. *Elec. Eng.*, April 28. The plate consists of a number of vertical rods of lead which are attached only to the upper transverse rod of a plate; the pasted active material which surrounds these is separated into sections by a series of insulated partitions which have holes drilled through them through which these lead rods pass; it is claimed that in this way expansion is allowed for. Great outputs per weight are

claimed for these plates. For a 15-plate accumulator weighing 34 pounds, the weight of the plates is 23 pounds, and at an 8-hour discharge a current of 35 amperes is maintained at an average voltage of 1.9. With 44 cells the capacity is 19 kw-hours or 25.5 hp-hours. The output is 12.17 ampere hours per pound of plate, or 8.25 per pound of cell.—Lond. *Elec. Eng.,* April 28.

Victoria Accumulator.—In a short contributed article in the Lond. *Elec. Rev.,* attention is called to the fact that the cells, judging from the recent description in that journal, are not uniform; it is remarked that the rate of discharge should also be given; it is thought from the comparison that the deductions are not conclusive. It is also claimed that the time test is more essential in those processes in which the oxides are mixed with some substance intended to serve as a binding material, or to increase the voltage or capacity, as vast experience has shown that such an admixture of inorganic substances, although sometimes quite satisfactory, in the beginning generally has detrimental results.—Lond. *Elec. Rev.,* April 28.

Method of Making Accumulator Plates.—The Vuillot method is briefly described in *L'Elec.,* April 29. The surface of the lead for the positive plates is transformed into carbonate of lead to any desired depth, and the plates are then placed in an alkaline bath in which the carbonate is changed into the oxide. The carbonization is produced by exposing the plates to carbonic acid gas; for the alkaline bath a mercurial solution is suggested and the formation into oxides is said to require only a few hours; the coating is said to be a very fine one. The description is only very brief and gives no further details. The negative plates are made in the usual way. The process is said to be introduced on a commercial scale in Brussels.—*L'Elec.,* April 29.

E. M. F. of Polarization.—A short article in the *Phys. Rev.,* April, Mr. MacNutt describes investigations to determine the portion of the power spent in an electrolytic cell, which appears at the electrodes in the form of heat due to an irreversible thermo-dynamic process which accompanies the deposition of the ions; strictly speaking, he investigated the e. m. f. of the energy for small values of the current, this having an important theoretical bearing, for if the action which takes place in the cell for infinitesimal currents is not thermo-dynamically reversible, then the ordinary principles of thermo-dynamics are not applicable to the electrolytic cell. His results show that this e. m. f. does not become zero with the smallest current density, and therefore the expenditure of this part of the power is due to an irreversible thermo-dynamic action, and the laws of thermo-dynamics therefore do not apply.—MacNutt. *Physical Review,* April.

This is followed by a note by Franklin stating that the trend of the curves obtained does not indicate with certainty that the e. m. f. is other than zero for a current which is actually zero.

Nickel.—A note states that a plant has just been started at Papenburg in Germany for the manufacture of nickel by means of an electrometallurgical process. The factory is said to be the most important of its kind in Germany.—*L'Elec.,* April 29.

REFERENCES.

Accumulator Construction.—In the continuation of the author's long serial in the Lond. *Elec. Eng.,* March 3, he gives brief descriptions and data of the Elieson, the Blot and the chloride accumulators. In the continuation of March 24 he gives further data of several cells and describes the Fulmen or Tommasi accumulator which is largely used for automobiles in France. In the issue of April 14 he gives a further brief notice and data concerning a number of different accumulators. He seems to favor the Guelcher accumulator, the data for which is 1.6 amperes per pound of cell complete and 7 ampere hours per pound. In the issue of April 28 he continues the brief description of various accumulators, giving in each case the capacity in amperes per pound.—Fitzgerald. Lond. *Elec. Eng.*

Electric Current in Chemistry.—The beginning of an article, the present portion of which is historical.—Lond. *Elec. Rev.,* April 28.

Calcium.—According to an abstract in the Lond. *Elec. Eng.,* April 28, Von Lengyel has obtained calcium by electrolyzing anhydrous calcium chloride in a graphite crucible containing a porous earthenware cell. It is not explained in the abstract what is contained in the porous cup. A current of 18 amperes at 70 to 100 volts is used. Von Lengyel. *Chem. Centralblatt,* 1898, p. 262.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Method of Measuring the Frequency.—What is claimed to be a very simple way for enabling correct determinations to be made with an error of less than one-quarter of a per cent., is described by Mr. Kinsley in the *Phys. Rev.,* April. It had already been proposed to use a vibrating rod fixed at one end and acted on at the other by the magnetism of the alternating current to be measured, being adjusted for synchronous vibration by changing its length, but he shows that this method is not accurate, as a very small change in length corresponded to a considerable difference of frequency. Instead of varying the length of the rod to be adjusted to synchronous vibration, he moves a non-magnetic rider on the rod and the method is then capable of more rapid and practical use. He discusses this theoretically and describes experimental investigations to corroborate the formulas. In order to determine the constants in the formulas it is necessary to determine only two simultaneous values of the time of a complete period and the distance of the rider from the end of the support; the absolute accuracy and correctness of these determinations depend largely on the accuracy of these constants. In an apparatus for measuring frequencies of about 133, a change of 1-cm in the position of the rider corresponded to a change of frequency of only one-quarter of a per cent., while if the rod were lengthened, in order to adjust for synchronism, the change of length would be only 0.007-cm. Thin rods were found to be better.—Kinsley. *Phys. Rev.,* April.

Flame Temperatures.—Mr. Berkenbusch tested a method proposed by Nernst for measuring the temperature in a flame and describes the results in the *Wied. Ann.,* an abstract of which appears in the Lond. *Elec.,* April 28. The source of error in such measurements by means of thermo-couples is due to the fact that the junction is assumed to have the temperature of the flame, but the loss by radiation and conduction is so great that the temperatures may be very different. In these methods the thermo-couple is heated to the flame temperature by an electric current, and there will therefore be no transfer of heat from the flame to the element, the temperature being the same as if the element were in a vacuum. The couple is therefore heated in a vacuum and the current necessary for each temperature is measured; the flame temperature is then determined from this current. No further details are given in the abstract from which this is taken. He found that the temperature of the non-luminous Bunsen burner was 1830°, presumably Centigrade.—Berkenbusch. *Weid. Ann.* No. 3, abstracted briefly in the Lond. *Elec.,* April 28.

Electric Pyrheliometer.—Mr. Angstroem, in the *Wied. Ann.,* describes an apparatus which he has constructed for measuring the radiation of the sun for terrestrial sources of heat, a brief abstract of which is given in the Lond. *Elec.,* April 28. There are two thin metallic strips blackened on one side, one is exposed to the radiation to be measured while the other is brought to the same temperature by means of an electric current. The radiation received from the source is then equal to that produced by the current, which can therefore be directly measured. No losses by convection, radiation or conduction need be allowed for, as they are the same in both strips. He measures the temperatures by thermo-couples.—Angstroem. *Wied. Ann.* No. 3, abstracted in Lond. *Elec.,* April 28.

Detecting Submarine Cable Faults.—An illustrated description of a method of "detecting" the arrival of faults on board when picking up submarine cables. The arrangement, which was suggested some years ago, has been experimented with, but the applications seem to have been few and insufficient; it is described now as a suggestion to others; it is likely to be of value only to small faults; it is said to be applicable also in the factory both for telegraph and electric light cables.—Murphy. Lond. *Elec.,* April 28.

Another short article on this subject, in the same journal, describes a method based on the same principle, which is practically identical. Its object is to ascertain when the fault in a cable which is being raised for repairs, comes on board, without being obliged to resort to successive cuttings. The method is said to have given good results. It consists essentially of winding a primary coil on the drum over which there are several turns of the cable; the cut end of the cable is connected through a galvanometer and condenser to earth. When a current is established in the primary another is induced in the cable as a secondary, and this flows through the galvanometer and the fault to earth, producing a throw in the galvanometer; when the fault is still in the sea the whole of the induced current flows through the galvanometer; but when the fault has passed the reel only a small portion of the induced current will pass through the galvanometer; there will thus be a very prompt indication that the fault has arrived on board the ship.—Jona. Lond. *Elec.,* April 28.

Wehnelt Interrupter.—A short but interesting article on this apparatus and its application by Prof. Hospitalier is given in *L'Ind. Elec.,* April 25. After some brief historical notes he describes the

apparatus and gives the results of what appears to have been a systematic investigation made by him. The coil used ordinarily gave a 6-cm spark, but with this interrupter he obtained 15 to 18-cm sparks and a frequency which varied between 1400 and 1500 per second; the current was obtained from 50 accumulators; the platinum wire was 0.88 in diameter, and 8 to 10-mm in length. All other things being equal, he found the following: An increase of the self-induction diminishes the frequency until at a certain value the interruptions cease, and after that the current passes continuously producing only electrolysis; a diminution of the self-induction increased the efficiency up to a certain value at which the phenomena ceases and the platinum wire becomes red hot, allowing a constant but small current to pass; the increase of voltage increases the frequency between certain limits; the increase of the diameter or length of the platinum wire increases the current but reduces the frequency; by properly proportioning the various elements, the frequencies can be varied between 1 per second and 2000; at low frequencies the interruption is less decided and the secondary sparks are shorter; heating of the liquid enables lower voltages to be used; Carpenter, for instance, uses acidulated water at 85° to 90° C., which enables him to use batteries of only 8 to 10 cells in series, but this heating introduces practical difficulties. The action of the interrupter, involving as it does so many different quantities, is very complex, and he therefore does not offer any theory of the action. He then makes some suggestions concerning the present and possible application of this system. In radiography it is already utilized for reducing the time of exposure, besides giving remarkably steady images on the fluorescent screen, and for such work the coils may now be reduced to very small ones, which are cheap and require no condenser. In wireless telegraphy the frequency should be as small as can be obtained, and therefore this interrupter is believed to be of advantage. For gas engines, especially those using power gases which are difficult to ignite, this interrupter will become very useful. A possible application is for igniting the gases. It may be used for high frequency work for which the Tesla system was formerly used, and it enables a very simple and practical form of welder to be made for watchmakers and jewelers, the current being obtained from the lighting mains. In conclusion he gives a list of references to the most important papers on this subject.—Hospitalier. *L'Ind. Elec.*, April 25.

The action of the interrupter is divided by Mr. Bary in a French Academy paper in *Comptes Rendus*, April 10, abstracted briefly in Lond. *Elec.*, April 28, into three distinct stages according to the inductance and resistance of the circuit and the e. m. f. With a small e. m. f. there is a simple electrolysis, at a certain higher value this gives away abruptly and a humming noise sets in which denotes the periodical interruption. With a still higher e. m. f. the third phase sets in, the gases disengaged at the anode being no longer luminous, but the platinum becoms hot and is surrounded by a layer of vapor. When the inductance is zero the interrupter phase does not set in at all and the electrolysis passes directly into the third stage, the point of transition depending only on the dimensions of the platinum wire and the resistance. On introducing an inductance the second phase sets in and the voltages within which the interrupter phase takes place are wider the greater the inductance. With a wire 0.35-mm thick, projecting 11.5-mm and an inductance of 0.0038 milli-henrys, there is no interruption; at 1.09 milli-henrys the interruptions set in, at 48 volts with a frequency of 930 per second, and continue up to 120 volts with a frequency of 1850; above that the third phase sets in. With 53 milli-henrys there is nothing but the interrupter effect from 36 to 180 volts with frequencies varying between 122 and 570.—Bary. *Comptes Rendus*, April 10, abstracted in Lond. *Elec.*, April 28.

In a French Physical Society paper by Villard, abstracted in *L'Ind. Elec.*, April 29, he shows that the spark produced by this interrupter is of the same quality as that produced by the Deprez break. The energy in each discharge is much less than when the Foucault break is used, and the powerful effects produced are therefore due entirely to the great rapidity of the sparks, and not to their individual intensity.—Villard. *L'Ind. Elec.*, April 25, and *L'Elec.*, April 29.

REFERENCES.

Electrical Determination of the Specific Heat of Liquids.—An Academy note by Negreano is reprinted in *L'Ind. Elec.*, April 25. The object of the method described is to compare the times required to raise equal volumes of the water and the liquid to be measured, to the same number of degrees, they being heated by the electric current.—Negreano. *L'Ind. Elec.*, April 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy Station at South Foreland.—A brief description, with an illustration of the mast and the apparatus, including also a portarit of the inventor, is given in Lond. *Elec.*, April 28. The following extracts may be of interest. It is said that the apparatus is strikingly simple. Experiments are to be tried between Newhaven and Dieppe across the English Channel, a distance of 64 miles, which is more than double that of the present transmission across that channel. An important improvement has been made so as to prevent the signals from one transmitter from being received by any other than the one which they are intended for, but how this is done is not described; it has been tried, however, with success, as it was possible to send messages from one of the present four stations to any particular one of the other three; moreover, messages were sent simultaneously between the two pairs of stations without interference. Marconi states that he has not in practice experienced the obstacle anticipated by most scientists, of the curvature of the earth; he believes there is no advantage gained in erecting the transmitting and receiving masts on the top of a cliff instead of on the beach. Marconi also stated that he knew nothing of any serious attempts to communicate across the Atlantic Ocean, and believes that real progress will only be made by shorter steps. He himself admits that wireless telegraphy is not likely to take the place of wire telegraphy for long distance commercial work, but for connecting islands or vessels separated by the sea, the system is now available up to a distance of 60 to 70 miles. The spark length of the coil at the South Foreland station is about three-quarters of an inch and the signals received are very clear. It is said that some of the French operators have reached a speed of 20 words per minute. The pole at South Foreland is 150 ft. high, and is in three lengths, being guyed together.—Lond. *Elec.*, April 28.

Improvement in Wireless Telegraphy.—It is announced in the English papers that Marconi has succeeded in eliminating cross signalling, that is, the interference of one message with another between two different stations. The device is not described, but is said to be ingenious and simple. It was tested on the English Channel, messages sent to Foreland being concentrated there, and received at no other point; a similar experiment was made with lightships communicating with each other. No indication is given of how this has been accomplished.—Lond. *Elec. Rev.*, *Elec.*, and *Elec. Eng.*, April 28.

Multiplex Telegraphy.—The *Elek. Zeit.*, April 29, begins a long translation in abstract of a description of the Mercadier multiplex system. This is based on what is called the monotelephone, that is, on the use of telephones which will vibrate only for certain definite frequencies, each telephone and its corresponding microphone being tuned to the same frequency; presumably telegraph signals are used, the sounders being telephones. Each microphone is actuated by an interrupted current produced with the aid of a tuning fork. The system was devised a number of years ago and was exhibited in Chicago in 1893, but it could be used only for sending messages in the same direction; the changes made since, and described in the present article, enables messages to be sent in different directions simultaneously, and consist in simplifying the apparatus and adding an artificial line and an adjustable condenser.—*Elek. Zeit.*, April 27.

Telephone Statistics of Switzerland.—A long extract of the official statistics of Switzerland for 1898 is published in the *Elek. Zeit.*, April 27. At the end of that year there were 31,918 subscribers and 35,536 stations, which is equivalent to 90 inhabitants per station. The yearly increase in the number of subscribers and communications is appreciably lower than that of previous years, showing that what may be called a saturation point is approaching. The income per subscriber for local service is about 90 francs ($18) per year. The increase in the underground circuits is much greater than in any other country in Europe; in 18 towns and cities the circuits are underground. The total length of underground wire, counting each wire of a loop separately, amounts to 42,895-km; 49 per cent. of the length of circuits in cities is underground.—*Elek. Zeit.*, April 27.

A Pacific Cable.—According to a note in the London *Times*, reprinted in the Lond. *Elec.* and *Elec. Eng.*, April 28, it seems that a distinct understanding has been reached concerning the Pacific cable. The British government will contribute in the form of a yearly subsidy, the full amount recommended in the committee's report of 1896 for a cable running from Vancouver to Fanning Island, and Fiji to Norfolk Island, from which it will branch to Queensland and New Zealand.—Lond. *Elec.* and *Elec. Eng.*, April 28.

Iceland Cable.—A note in the Lond. *Elec.*, April 28, states that a new proposal has been made which may possibly lead to some result.

The Meteorological Institute of Copenhagen proposes to have other similar bodies in Europe and America join it in subscribing for the cost of daily telegraphic reports from Iceland and the Faroe Islands. A cable company has agreed to lay the cable if 14 meteorological institutes support the scheme.—Lond. *Elec.*, April 8.

REFERENCES.

Telephones.—The paper by Gavey (see Digest last week) is concluded in the Lond. *Elec. Eng.*, April 28, and is followed by the discussion. An abstract is also begun in the Lond. *Elec. Rev.*, April 28.

Simultaneous Telegraphy and Telephony.—A brief illustrated description of the improved Van Ryssellberghe system.—*L'Eclairage Elec.*, April 22.

MISCELLANEOUS.

Manufacture of Glass by Electricity.—A note concerning the Kroll process which is used in an experimental plant at Cologne, is given in *L'Elec.*, April 29. This plant is said to have given excellent results and to have shown the superiority of that method over the usual one. The process consists simply in the use of the electric furnace for fusing the raw materials for the manufacture of glass. There is said to be a saving of coal of "about three-fifths;" the installation is much more simple than the furnaces ordinarily used; the heating is done without fear of particles of carbon and ashes getting into the glass. The heat which in the ordinary process is transmitted to the neighboring ground and is a total loss, is saved, as is also much of the radiated heat. The materials are fused by means of the electric arc, and only small quantities at a time may be melted; for instance, an ordinary furnace which requires 30 hours for heating one charge, is in this case replaced by one which requires only 15 minutes; thus the use of large furnaces may be avoided and the fusion may be begun or stopped at any time without loss of energy, as, for instance, on Sundays and holidays.—*L'Elec.*, April 29.

Efficiency of the Human Machine.—A Royal Society paper by Dr. Marcet and Mr. Floris is briefly noticed in the Lond. *Elec.*, April 28. They found that the efficiency of man as a machine is a little below 20 per cent.; this seems to be based on a useful and painstaking series of researches with this difficult and complex problem. This efficiency is far higher than that of an ideal Carnot engine working between the limits of temperature found in the human frame. It is so high that if he were a simple heat engine his vital organs would have to work at temperatures like those in the cylinders of a gas engine. The precise mechanism of the vital progress is still obscure, and all that can be said is that it is a physico-chemical engine the action of which differs from that of every known living engine.—Marcet and Floris. Lond. *Elec.*, April 28.

Reconstructed Granite.—The *St. R'y Jour.*, May, describes a new fireproof material. It is made of granite chips, pulverized, moulded into form and fused together at a temperature of 3000° Fahr. It can be heated red hot and thrown into cold water without being injured. It resists the action of acids and alkalies and is frostproof, having been tested by liquefied air at a temperature of 350° below zero, without injury. Its crushing strength is very high. Two moulded forms are shown: One is the sectional insulator block used between the sections of the third-rail system at Manhattan Beach; the other is used on the Brooklyn Elevated Railway. At Niagara Falls a test showed that it required 56,600 volts to penetrate about one-half inch of this material.—*St. R'y Jour.*, May.

REFERENCES.

Maritime Electrical Association.—A full account of the proceedings of the second annual convention of this association held in Halifax, April 18. The papers which are reprinted in full with the discussion, are as follows: "The Evolution of the Fire-Alarm Telegraph," by Colpitt; "Reminiscences," by Hamilton; "The Iron Armored Conduit Installation at St. Mary's Cathedral, Halifax," by Anderson; "Steam Engineering," by Freeman; "Electric Motors," byMcKeen; "The Long Distance Transmission of Speed," by Winfield, and "The History of Electric Light in Halifax," by Pickles.—*Can. Elec. News*, May.

International Electrical Congress.—A list of the members of the organization committee of the International Congress which is to meet in Paris in 1900. A meeting was held on May 12, at which Mascart was elected president. Nothing is said of the work which the Congress is to undertake.—*L'Ind. Elec.*, April 25.

Electroculture.—A reprint of the article by Moira, noticed in the Digest May 6.—*L'Elec.*, April 15.

Workshop Practice.—An illustrated description of various machines and methods used in electrical workshops.—Bauch. *Elek. Anz.*, April 16 and 23.

Biographical.—A biographical sketch of Lord Kelvin, including portraits at various ages and descriptions of some of his inventions.—Cormack. *Cassier's Mag.*, May.

New Books.

INDUCTIVE ELEMENTARY PHYSICAL SCIENCE. With Inexpensive Apparatus and Without Laboratory Equipment. By F. H. Bailey, A. M. Boston: D. C. Heath & Co. 106 pages, 33 illustrations. Price, 50 cents.

This little book is devoted to an elementary teaching of hydrostatics and hydraulics It is addressed partly to the teacher and partly to the elementary student. The teaching is based upon the inductive method, employing numerous simple experiments with readily procured, inexpensive apparatus.

LIGHTING BY ACETYLENE. By Killiam E. Gibbs, M. E. New York: D. Van Nostrand Company. 170 pages, 64 illustrations. Price, $1.50.

This little book is a brief résumé of the carbide and acetylene art to date, evidently written or compiled for the reader who only wants a smattering of something and nothing thorough or conclusive. In view of the excellent French work of Charles Perrodil on the subject, the idea at once suggests itself that even an abridged translation of the latter would have served a better purpose.

The first part of the work, devoted to the history of the art, is the story of the discovery of carbide of calcium and the respective alleged or actual claims of the different claimants to the honor.

The discussion of the electric furnaces in a short chapter of only ten pages, mostly taken up by illustrations, is nothing short of trifling, considering what has been done in this art that would make both interesting and instructive reading.

A short chapter closes this subject, entitled "A Continuous Process Electric Furnace," implying apparently the existence of but one of this sort. This closing chapter on the furnace art is merely an extract from a patent specification, and no mention is made as to whether a furnace of this type ever operated continuously or not, and no mention whatever is made of the Horry continuous process furnace, which is now well known and long in operation. The division and classification of generators is good and the selections for illustrations are well chosen. This remark applies equally to the description of acetylene lamps given.

The subject of burners closes the work rather unsatisfactorily, being far from up to date as regards recent advances in this direction in both France and Germany.

DAS ELEKTROTECHNISCHE INSTITUT DER GROSSHERZOGLICHEN TECHNISCHEN HOCHSCHULE ZU KARLSRUHE. By Professor E. Arnold. Berlin: Julius Springer. 59 pages, 32 illustrations.

This is a pamphlet giving the description of the new building recently added to the Hochschule for the Department of Electrical Engineering. Detailed information regarding the equipment is given and there are a number of fine illustrations of the interior The outside dimensions of the building are 138 x 135 ft; there is an interior open space 44 x 54 feet. The building consists of a basement and two stories, and is designed to accommodate about 100 students.

In the basement are located four special laboratories; one for cable testing, one for high-tension testing, one for photometry, and one for calibrating measuring instruments. The latter adjoins the battery room, which contains 180 accumulators. The main power supply is a gas engine coupled directly to a 22-kw direct-current dynamo, and to a 22-kw three-phase dynamo.

The dynamo room is located on the ground floor, and measures about 80 x 36 ft. This contains a variety of small motors, dynamos and rotary converters, and a slow-speed gas engine coupled directly to a 7-kw multipolar dynamo. There appears to be no shafting in this room. A small workshop is connected with the dynamo room, supplied with lathes and necessary tools. An electric traveling crane enables convenient handling of the machinery. There are also five laboratories, about 30 x 15 ft., on this floor for general work.

The upper floor contains one large lecture room, with seats for 196 students; one small lecture room, seats for 76 students; one large construction room, and a number of smaller rooms.

It is evident from the description given that every detail has been worked out with great care, and that the equipment is well suited for its intended purpose.

General Exhibition Notes.

During the past week, the exhibition took shape rapidly and the opening of the second week of the show found practically every exhibit in shape and ready. It would have been a wonder if this exhibition had been different from any other as to unpreparedness when the button was pushed, but it was to be hoped that electrical folk would, with the facilities they enjoy, constitute themselves an exception to the rule. As things are now, however, the garden is an extremely interesting and beautiful place to visit, and with favoring weather, the exhibition should score a success that will be gratifying to the National Electric Light Association and to the management. The attendance grew steadily all the week, and was not only excellent as to numbers but remarkable as to quality. There can be no question that the fine display of automobiles has attracted the attention of social New York, for those exhibits are constantly crowded with visitors whose evident object it is to secure data as to prices, styles, etc., in regard to the numerous types of vehicles shown by the five leading manufacturers in this field.

Notes are made below as to many of the exhibits, of which illustrations are also given. The members of the National Electric Light Association for whom preparations are being busily made will certainly find plenty to occupy their time aside from the regular convention work, and will be glad to see how much has been done once again to familiarize the public with electrical opportunities and uses, both by the exhibitors and by those who have been instrumental in getting them together in the garden.

Last Saturday, as described elsewhere in more detail, the New York Electrical Society celebrated the Volta centennial in the garden concert hall. This week on Friday, it is proposed to give prominence to the export feature of electrical manufactures, and some fifty of the foreign consuls in this city have been invited to attend. During the week past, the number of out-of-town electrical visitors has been quite large, including such well-known men as C. R. Huntley, Samuel Insull, A. A. Pope, G. H. Day, Frederic Nicholls, H. A. Foster and H. M. Atkinson. The general visitors have included Mrs. de Navarro (Mary Anderson); the Vanderbilts, Mrs. Mary Halleck Foote, and many other notabilities.

It is understood that one of the evenings of the coming week, Mr. C. E. Tripler is to give a lecture with experiments, on liquid air, before the National Electric Light Association, all of whose members are greatly interested in this subject and its possibilities. The recent descriptions and discussions in magazines and papers have but whetted curiosity in this direction.

This week a beautiful automobile has been put up to be balloted for, going to the actress receiving the greatest number of votes, and all the electrical effects in the basement—now a very attractive "grotto," have been put in full working order.

An Exhibition Dinner Given by Pres. A. M. Young.

On Wednesday, May 10, a dinner was given at the Union League Club, Fifth Avenue, by President A. M. Young, of the National Electric Light Association to the committees and workers who had been engaged in bringing to success the electrical exhibition and the preparations made for the coming N. E. L. A. convention. The idea was that an opportunity would be afforded for better acquaintance and for a general review of the work up to date and it was certainly realized in a most happy manner. The list of those present is as follows: A. M. Young, C. O. Baker, Jr., H. L. Shippy, George F. Porter, H. H. Harrison, L. F. Requa, Luther Stieringer, T. C. Martin, Herbert Laws Webb, E. F. Peck, Ira W. Henry, C. W. Rice, Prof. W. S. Franklin, Charles W. Price, J. W. Lieb, Jr., Paul Spencer, E. A. Leslie, E. H. Stevens, E. A. Maher, Jr., A. J. Purinton, A. H. Patterson, W. S. Barstow, Thomas E. Murray, Theo. Beran, William F. Zimmerman, J. W. Godfrey, Charles T. Hughes, R. A. C. Smith, Charles H. Werner, George G. Blakeslee, W. G. Bushnell, H. M. Atkinson, W. H. Meadowcroft. The dinner was one of the very best efforts of the club chef. President Young thanked his guests for their presence, and brief remarks were made by Messrs. Hughes, Leslie, Price, Baker, Martin, Smith and Prof. Franklin. After the dinner the party were taken to the garden in automobiles.

Transmission Across the Garden by Radiophone.

On Saturday last, a series of interesting experiments at the garden were brought to a finish in a successful public demonstration of the beautiful radiophone of Prof. Alex. Graham Bell, aided by a General Electric searchlight. The exhibit has attracted much attention by its novelty and ingenuity. Experiments on the transmission of speech by means of a ray of light were first made by Prof. Bell in 1880, when he called the apparatus employed for the purpose the "photophone." The transmitter consisted of a plane mirror at the transmitting station, so arranged as to reflect a beam of light upon a selenium cell in circuit with an ordinary telephone receiver at the receiving station. The transmitting mirror served as a telephone diaphragm, a resonating chamber and mouthpiece being placed at the back. On speaking into the mouthpiece the mirror was vibrated, and these vibrations altered the intensity of the beam of light. The changes in the beam of light resulted in the selenium cell, acting in accordance with its well-known property of altering its electrical resistance under the influence of light, setting up corresponding changes in the receiver circuit and so producing vibrations in the receiver diaphragm similar to those communicated to the mirror of the transmitter.

Prof. Bell's experiment aroused much interest and discussion in the scientific world, and was followed up by various other experiments by himself and others. It was found that the selenium cell could not be relied upon, as its sensitiveness to light changes with age. Fortunately, a very simple receiver was devised by Prof. Bell which removed the necessity of employing selenium. This receiver consists simply of a glass bulb or tube containing a small pellet of carbonized fibre. To the opening of the tube is connected an ordinary phonograph ear tube, and this simple device is all that is rethat is required for the photophonic receiver. Further investigation of the action of Prof. Bell's invention determined that it was really due to heat effects, and not to light. The well-known French electrician, Mercadier, in a series of experiments proved that the results obtained were due to heat effects, and suggested that the name of "radiophone" was more appropriate than "photophone." Since these experiments nothing had been done with the radiophone until the subject was taken up recently by Mr. Hammond V. Hayes, of the technical staff of the American Bell Telephone Company. In Mr. Hayes' experiments he found that, using a mirror and a reflected beam of light in the experiments of Prof. Bell, the transmission of speech was extremely feeble, and audible to a trained ear only. Without describing in detail Mr. Hayes' experiments in the development of the radiophone, it may be said that the extreme sensitiveness of the receiver led to an improvement in the transmitter.

It was found in experimenting with an arc light as the source of the transmitting beam that a noise was heard in the receiver which was traced to the commutator of the generator to which the lamp was connected. This experience pointed directly to a new style of transmitter. Experiments were made to find a means of directly varying the heat produced by an arc light in such a way as to cause the heat rays to convey to the radiophone receiver the desired sounds. Numerous ways of reaching this result were tried, the simplest and most efficient so far discovered being the one used in present experiments. This is to connect in a shunt circuit about the arc a telephone transmitter specially designed to carry a large amount of current. By this arrangement current is shunted from the arc in proportion to the resistance of the transmitter, the resistance of the transmitter of course varying in accordance with the vibrations of its diaphragm. The variation thus produced in the current of the arc lamp necessarily produces corresponding changes in the heat rays emitted by it, and these changes affect the material in the glass bulb of the receiver in such a manner as to produce minute variations in the column of air contained in the receiver and ear tubes.

It is well to state that the entire apparatus is still in an experimental stage, and is only exhibited at present in New York on account of the opportunity offered by the Electrical Exhibition to exhibit an experiment of particular beauty. It has not yet been determined how far speech can be transmitted in this way, the distance naturally depending largely upon the power of the light used at the transmitting station. No experiments have yet been made to determine the limits of transmission under the most favorable circumstances, but as an indication of future possibilities it may be said that in Mr. Hayes' experiments in Boston he has succeeded in transmitting Morse signals by means of the radiophone over a distance of two miles. The telephonic apparatus used at the garden is placed in the upper gallery, in sound proof silence booths, one of which contains the telephonic transmitting set, and the other the receiving mirror and ear tubes. Outside the transmitter cabinet stands the General Electric searchlight, an arc taking about 35 amperes. Speech in short messages, the counting of numbers, and the playing of a cornet have been sent across the hall on the beam of light with excellent results. It is very curious to see the arc bob responsively when the numbers one to ten are reeled off.

In The Grotto.

After a large amount of work, Messrs. Stieringer, Parsell, Mayrhofer, Nathan, and Capt. Sorchio, of the diving exhibit, have succeeded in organizing a most interesting series of effects in the basement of the Garden, to which reference can only be made in passing in this issue. The exhibits there include diving with electrical effects, a cave charged with static electricity, a Röntgen ray booth, the Caldwell-Wehnelt interrupter booth, the Mimic Theatre, the grotto itself, and the New York Bell Telephone Company's theatrophone. A good hour can be be spent to advantage in "Stieringer's subway."

Volta Night at the Garden.

The 198th meeting of the New York Electrical Society was held at Madison Square Garden on Saturday night, May 13, to celebrate the centennial of the discovery by Volta, of the electric battery. The meeting was held in the concert hall and was attended by four or five hundred persons including the representatives of several Italian societies. On the stage was placed a large plaster cast medallion of Volta, being one of a series now being put on the new Edison station in this city in terra cotta. This medallion was draped in American and Italian flags. Back of the stage were two large electric light signs, one of which read "Volta, 1799" and the other "N. Y. E. S., 1899." Both of these were prepared for the occasion by the General Electric Lamp Works at Harrison, under the supervision of Mr. W. H. Meadowcroft.

President Dunn, who opened the exercises was supported on the platform by Cardinal Branchi, Italian Consul, Dr. R. O. Doremus, Prof. C. A. Doremus, President C. O. Baker, Jr., of the Exhibition Company; G. H. Guy, secretary of the Society; G. G. Ward, vice-president, of the Commercial Cable Company; Francis W. Jones, electrician of the Postal Telegraph & Cable Company, who was the society's first president; John W. Lieb, Jr., past president, New York Electrical Society, T. C. Martin; Philippo Torchio, member of the American Institute of Electrical Engineers, and the officers

MEDALLION OF VOLTA.

of several Italian societies, some of whom came in uniform. After Mr. Dunn's eloquent introductory remarks, Mr. Lieb, who erected the first central station in Italy at Milan, made an address in Italian, and Consul Branchi acknowledged the tribute to his country and to the memory of Volta Mr. F. W. Jones than gave an admirable review of the life work of Volta and its momentous results, and stated that the telegraphers of America had contributed $250 towards the bronze wreath for Volta's monument besides sending Mr. Paul Burton as a delegate to the telegraphic conference in connection with the Volta Exposition at Como, Italy. An address was then made in Italian by Mr. P. Torchio, and it was followed by a most spirited and beautiful speech by Dr. Doremus, who suggested that American electricians who owed so much to Volta ought to set up a fine monument to his memory in New York City, where so many Italians made their home.

President Dunn read the following letter from Mr. Edison:

New York, May 11, 1899.

Gano S. Dunn, Esq., President New York Electrical Society:

Dear Mr. Dunn—I am in receipt of your kind invitation to attend the Volta Centennial exercises at the Electrical Exhibition in Madison Square Garden on Saturday, May 13, and regret my inability to be with you on that interesting occasion. I need hardly say that I am warmly in sympathy with the sentiment which prompts your society to pay this tribute to the memory of the great Italian to whose investigations and researches in electricity the world owes so much. The discovery of the primary battery or voltaic cell was one of the monumental landmarks in the advance of electrical science and application. During the memorable fifty years of the development of land and sea telegraphy, it was the one source of current. Without it the modern telegraph would not have existed, and without it the next step in the discovery of electro-magnetic induction could not have been made by Henry and Faraday, giving in turn the later electrical arts that are based upon the dy-

namo. And even to-day, cells of the general voltaic type remain the most simple, perfect and reliable instruments for electrical measurement that we possess.

I am glad to learn that your society is to send fraternal messages to the Italian electrical bodies and to the official Telegraphic Congress convening at Como, the birthplace of both Volta and the voltaic cell, and I would beg that I may be allowed the honor of associating myself with you in these expressions of cordial and hearty good will towards the countrymen of one of the noblest pioneers of our electrical art. Believe me, yours very truly,

(Signed.) Thomas A. Edison.

President Dunn read also the following telegram from Prof. Elihu Thomson: I am in reecipt of your invitation to attend the Volta Celebration of the New York Electrical Society at Madison Square Garden on Saturday night. I regret I cannot be present at the celebration, but I send my best wishes for its success.

By unanimous vote of the meeting, the subjoined messages were then sent to Italy, Messrs. G. G. Ward and F. W. Jones being appointed a committee for their despatch:

To the Associazione Elettrotecnica Italiano, Milan:

Electricians of America, through the New York Electrical Society meeting at the Electrical Exhibition in New York on the Centennial of Volta's memorable discovery of the electric battery, extend to their brethren in Italy congratulations on the great century of developement that has followed the results due to Italian skill and science.

To the President Volta Electrical Exhibition: Como, Italy.

The Electrical Exhibition in New York City offers through the New York Society to the Electrical Exhibition at Como, celebrating Volta's memorable invention of the electric battery, heartiest wishes for its success and for the success of the telegraphic conference.

To the Italian Premier:

The Electricians of America, celebrating the Volta Centennial in New York, extend heartiest congratulations to the fellow-workers in Italy, and in doing so desire to express the hope that the work of such pioneers as Galvani, Volta, Pacinotti and Ferraris may be renewed and repeated by other members of the Italian race in the century which is now dawning. America owes a deep debt of gratitude to Italy for electrical discoveries which have done so much to abridge distance and add to the welfare of mankind. Please communicate these sentiments to King Humbert in the name of the New York Electrical Society, Gano S. Dunn, President.

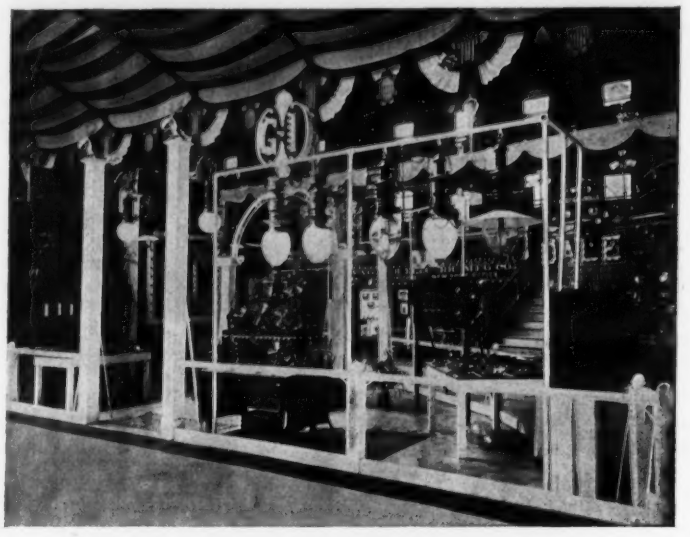
Bossert Steel Boxes.

The Bossert Electric Construction Company, Utica, N. Y., which is represented in New York by Mr. R. B. Corey, makes a display of its outlet, cutout, switch, main distribution and branch-circuit boxes, also steel panel boards lined with slate. These boxes are reinforced by malleable iron legs, which also serve as a means of attaching the box to the wall. The Bossert Company manufactures these boxes with the inside work complete, designed for any number or arrangement of circuits, with or without switches, and for either two or three-wire systems. These boxes are provided with plate glass doors set in a highly polished brass frame and fitted with lock and key. The exhibit is shown associated with that of the Columbia Camp, in one of our pictures.

The "G. I." Exhibit.

There is an inveterate tendency in electrical circles to abbreviate down to mere initials the names of the leading manufacturing companies. The object, of course, is to save time and avoid vain repetitions, and when the manufacturer is able to assist this electrical desire for brevity he not only earns a debt of gratitude, but does a clever piece of advertising at the same time. The General Incandescent Arc Light Company has made a distinct hit in thus settling down to the initials "G. I.," which it treats practically as a trademark, and which are heard several thousand times a day at the garden in connection with the exhibit occupying one of the large triangular spaces at the Madison avenue entrance, on the main floor.

A view is presented of the exhibit, but hardly begins to do it justice on account of the large variety of objects that are comprised, and which the eye of the observer has to disengage slowly from the surroundings. The exhibit contains goods made by the "G. I." Company for itself and other allied interests, including the Wright Discount Meter Company, the Paragon Fan & Motor Company, the New York Electric Equipment Company and the Chicago Rheostat Company. The following samples and detail devices are included in the notable display thus made: A full line of direct-current and alternating current arc lamps, plain type and interior or enclosed arcs, for 110 and 220-volt circuits; a full line of standard knife switches; a line of quick break railway switches; new automatic knife switches; a line of tablet and distribution boards; a line of Paragon desk, bracket and ceiling fan motors all of the 1899 model; "G. I." incandescent lamps, Wright discount meters in operation, Hoyt discount meters in operation, a full line of Chicago Rheostat Company's rheostats, a full line of outlet boxes, flush receptacles, "G. I." flush switches, Molendo hooks and receptacles, and samples of "G. I." underground apparatus (Tailleur patents). It will be seen that excepting generation apparatus the exhibit covers a remarkably wide range of devices, appliances, fixtures and material, and the members of the electrical fraternity and of the lay public whom it fails to interest are few, indeed. The exhibit is finished in



THE "G. I." EXHIBIT.

white, red and gold. Mr. Martin J. Insull and his associates in the preparation of this very attractive and tasteful display under the "G. I." banners are entitled to hearty congratulations.

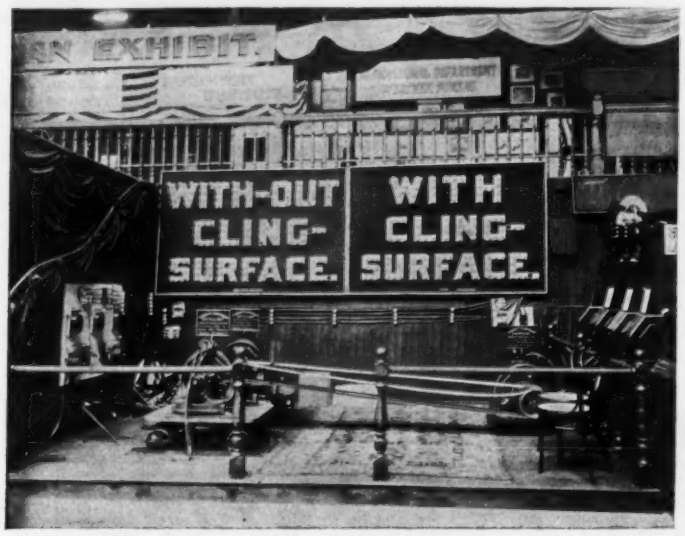
Cling Surface.

Those interested in belt transmission of power find in the display of the Cling-Surface Mfg. Company, of Buffalo, N. Y., an object lesson that is well worth, and generally receives, their careful attention. This exhibit is a practical one, for the practical man, and is devoid of any fancy frills which might detract from its real purpose. The object aimed at here is to demonstrate that an average of 40 per cent. more power can be transmitted by a belt treated with Cling-Surface than with one not so treated. This is done by means of machines arranged in this manner: A direct-current 7½-hp 110-volt Westinghouse motor, running at 750-rpm, drives, by means of two four-inch belts on its one pulley, two 3¾-kw, 125-volt Westinghouse multipolar dynamos, each running at 1000-rpm. Thus the two dynamos being of the same capacity and deriving their power from the same source enable a comparison of the performance of the two belts, which are of the same size, and made from the same piece of leather. The tension on the belts is obtained by means of heavy spring scales pulling at the back of the machines. The belt treated with Cling-Surface has a tension of 115-lbs., while that without Cling-Surface pulls on its machine with a tension of 200-lbs. The Cling-Surface belt runs slack while the other one runs tight, and the slackness of the former belt may be varied within a considerable range with but little effect on the lamps. A similar variation in the tension on the tight belt, however, produces a very marked change in the light. Tests are made to show that there is no slip on the Cling-Surface belt, while on the other there is constant slippage. It is claimed that belts treated with Cling-Surface do not slip, and that they will transmit power up to their breaking limit. In this exhibit the loose belt does twice the work of the tight belt, thus demonstrating the advantage to be gained

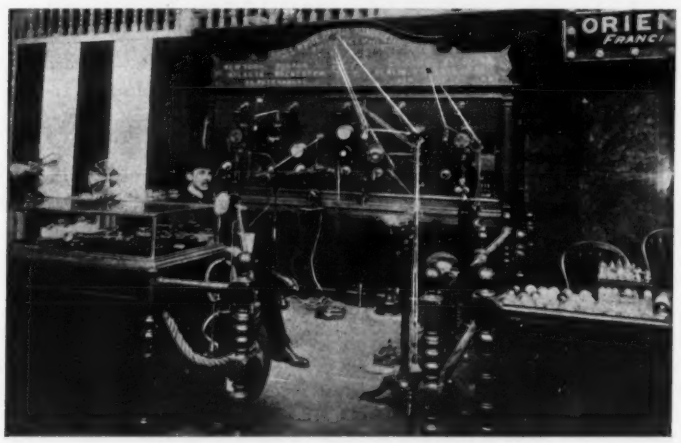
by the use of Cling-Surface. The load on the machines consists of two lamp signs at the back of the booth, reading: "Without Cling-Surface," and "With Cling-Surface." These two signs enable a comparison of the results of using treated and untreated belts. The interests of the Cling-Surface Manufacturing Company are looked after by Mr. Albert B. Young, manager.

The S. S. White Dental Manufacturing Company.

Dentists, surgeons and electro-therapeutists find much to interest them in the comprehensive exhibit of the S. S. White Dental Manufacturing Company, of Philadelphia, whose interests are looked after by Mr. W. S. Bennett, the company's New York representative. To enumerate all the articles on exhibition would take up a great deal of space, but reference to the more important articles will be of general interest. There is a No. 2 motor and treadle rheostat for 110 volt direct current circuits; a new surgical engine, operated by flexible cable, and cord driven, for 110 volt circuits; the Partz acid gravity battery; a die-sinker's engine; cataphoresis outfits and electrodes; motor generator and transforming device enabling the use of the following named appliances from 110-volt direct-current circuits: Electric dental pluggers, dento-electric cautery, mouth examination glass, mouth-illuminating lamp and electric hot air syringe. A fan motor and a dental engine are driven by 2 cells of storage battery charged by 6 cells of "Excello" gravity battery.



AN ILLUSTRATION OF BELT DRIVES.



ELECTRICAL DENTAL APPARATUS.

The "Excello" battery is made by the Burnham Electric Company, Boston, Mass., and is of the closed circuit type. In a show case are shown a great variety of instruments and appliances. The various dental and surgical instruments are arranged at the back of the booth so as to show them in practical operation.

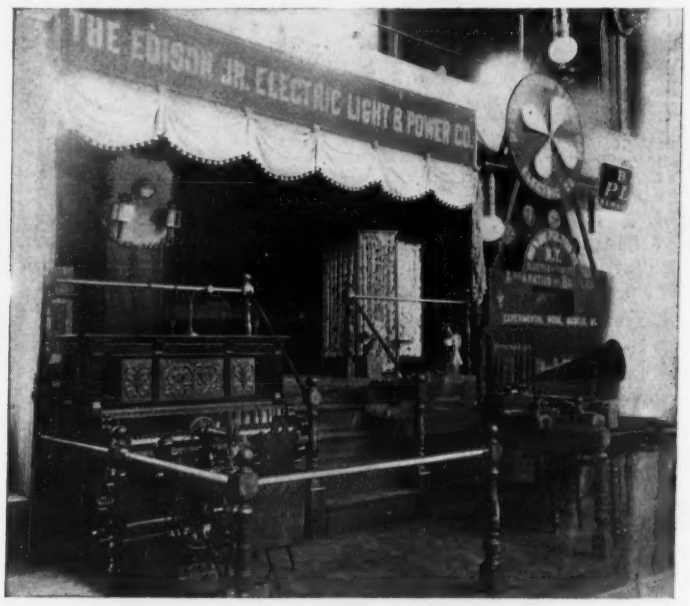
Orient Incandescent Lamps.

The Orient Electrical Company, Youngstown, Ohio, has a booth on the main floor, but its exhibit is far more extensive than the limits of its booth. Mr. A. H. Granger, of the New York office, calls attention to the fact that his company supplied nearly all of the sign lamps used in the garden. At the back of the booth is a large board in the shape of an incandescent lamp, across the face of which is the word "Orient," in blue 4-cp 14-volt lamps. At the back there is also a sign containing the name of the company, which is bordered by frosted lamps. Mr. Granger recently obtained a contract for lamps for the Singer Building in New York City, which is said to be the largest contract given out lately. This company's lamps are guaranteed for 650 hours. The colored lamps, of which this company makes a specialty, are guaranteed in every respect. Among railway companies supplied by the Orient Company may be mentioned the New Jersey Electric Railway, Coney Island & Brooklyn, Staten Island Midland and the Danbury & Bethel.

AN INCANDESCENT LAMP DISPLAY.

Mr. T. A. Edison, Jr.'s, Exhibit.

The Edison Jr. Electric Light and Power Company, New York, exhibits samples of different size cells of the Edison, Jr., primary battery, which is designed for general lighting. In this battery the wires and connections are placed at the bottom of the cell and coated with an acid-proof cement rendering them permanent and indestructible. The electrolyte is dilute sulphuric acid, the depolarizer nitrate of soda and the electrodes are zinc and carbon. The battery is constructed in boxes of 2, 4 and 8 cells. A practical application of this battery is shown in the operation of a self-playing piano, the music of which always attracts an appreciative crowd. There are also shown carriage side lights and headlights supplied by similar means. At the back of the booth is a darkened cabinet containing some Geissler tubes, which are operated by an induction coil excited by the current from a battery of Edison Jr. cells.



A PRIMARY BATTERY EXHIBIT.

The Lighting of the Electrical Exhibition.

There are few, if any places in this country, that can equal Madison Square Garden as a centre for spectacular display on the largest scale. Hence, it is not only the scene for such entertainments as the Wild West, Barnum's Circus, the Horse Show, etc., but is resorted to whenever an unusually large fair or exhibition is to be held. Yet it has not generally been regarded as an ideal place for such affairs, on account of the extreme difficulty encountered in dealing with the illumination and decoration of the roof, a huge, ungainly structure of metal and glass. The steel ribs are usually picked out with incandescent lamps and a large central fixture with rings of incandescents helps them out. Then, as elsewhere, festoons and streamers are freely used, but in this case they break up the more ornamental lines of the structure itself. Moreover the light is also chiefly thrown up into the roof instead of upon the floor where it is needed. Last year at the electrical exhibtion, the problem was boldly grappled with by placing in the centre, in the stead of the incandescent reflector chandelier a handsome and graceful "arcolier," which carried no fewer than thirty-seven enclosed arc lamps. The effect was very fine in many ways, and the fixture was greatly admired, but it did not reach the heart of the problem, namely, the artistic treatment of the roof and the satisfactory lighting of the vast floor at one and the same time. Besides there was no little clash between the incandescent lighting in the roof and the arc lighting from the "arcolier" and the arcs on standard curved neck iron posts placed around the promenade by the New York Edison Company.

This year the matter was turned over to Mr. Luther Stieringer, the well-known consulting electrical engineer of the Chicago, Atlanta and Omaha Expositions, with the request that if possible he evolve some original way of dealing with the question of "converting a baseball ground into a society ball room." This expert who went so far at Omaha as to obtain all its beautiful outdoor illumination effects in the Court of Honor with incandescent lamps, at once insisted that here more particularly, as it was an indoor space, arcs must be entirely discarded as a factor. While they could not be eliminated altogether because many exhibitors would use them around their booths, they were not to be used in any part of the general scheme of decoration and illumination.

In order to effect his purpose, Mr. Stieringer has made an artificial ceiling or awning, with the ribs supporting the material, which is yellow and white, in broad bands, and edged with a fringe. The ribs carry about 720 incandescents which make a pretty accentuation of the structural effect. From the ribs depend 32 clusters of 16 Imperial incandescent lamps, frosted, and held in circular white boxes. These boxes are about midway between the artificial ceiling and the floor and are in every case central to the aisles they illuminate. The law that the source of light should be removed from the object lighted is very well observed in this manner. The distribution obtained is remarkably equable and uniform, it being, of course, intensified by the shield clusters of incandescents all around the galleries and by the special lighting in the exhibits and signs on the floor, where several hundred incandescents are thus employed.

Mr. Stieringer is to be heartily congratulated on the charming effect he has secured. The scheme worked out has merit in its feasibility and practicability, and the lighting is noteworthy for its brilliancy and cheerfulness. It is a good object lesson for future events, and we should greatly like to see a repetition on the occasion of some great ball or festival, when all the conditions would be favorable to the best results.

Electric Heating and Cooking.

The exhibit of electric heating and cooking apparatus made this year across the east end of the garden, by Mr. J. E. Sayles, the New York agent of the American Electric Heating Corporation and the Heating Department of The Simplex Electrical Company, exceeds in interest and value all previous exhibits of the kind. Not only are the regular goods of the kinds heretofore shown improved in construction and finish, but new and important additions have been made.

Especial attention is directed at the exhibit to the thermostatic electric regulator which now renders it possible to employ electric heat in all processes where accuracy is essential. It is shown in control of a baking oven, where the degree of heat is varied by the movement of a tiny switch, giving four different temperatures from 380 degrees to 500 degrees F., adpated to different kinds of work. Not only does it secure accuracy of temperature, but it makes it entirely safe to employ a much larger amount of current than it was before safe to employ. This results in heating up the oven in a much shorter time, while the control exercised not only prevents overheating, but secures great economy of current consumption—at least one-third saving being effected.

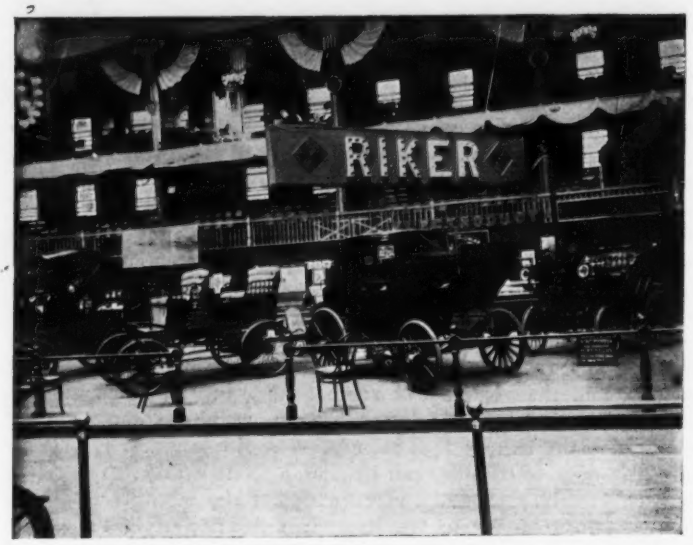
The regulator is also shown applied to a bacteriological incubator and other laboratory apparatus. Its use in laboratories will be welcomed on account of its cleanliness and accuracy, as well as its freedom from the danger which attend the use of gas flame in such places.

The exhibit is in full operation during the hours from 2 to 11 p. m., and visitors not only watch the work but are invited to take hot cakes, afternoon tea, etc. Literally hundreds avail themselves of this opportunity to taste the first food they have ever seen cooked electrically, and it is here that the educational value of such an exhibition is seen to its fullest degree.

EXHIBIT OF ELECTRIC HEATING AND COOKING APPARATUS.

Riker Automobiles.

For fifteen years past Mr. A. L. Riker, of the Riker Electric Company, has been devoting his energies and inventive ability largely to the application of motors to launches and vehicles, and during the past five years he has scored some notable successes with his automobiles. The display made by him at the Garden this year is an emphatic demonstration of his skill and taste, and as the exhibit is changed from time to time, it is a constant surprise and attraction even to those who note it daily. The Riker phæton shown is rated to run 25 miles on one charge of battery. It weighs 2000 pounds and has a 1½-kw motor, with 44 cells of 66 ampere hours. The one motor drives on the rear shaft and the steering is done from the



SOME NEW AUTOMOBILES.

front. A band brake is employed, with an emergency brake on the rear tires. The Riker victoria shown, much the same in general construction as the phæton, has run over 8000 miles. The Riker surrey has a 2-kw motor, with 44 cells of battery of 90 ampere-hour capacity. It has a radius of 30 miles, will carry four people and weighs 2500 pounds. The beautiful Riker broughan is a distinctly new type, built as to carriage body from French designs. It has two 2-kw motors, both on the rear axle, driving each rear wheel independently. Like all the Riker carriages, it steers from the front. It is supplied with 44 cells of 100 ampere hours capacity, and weighs, all told, 4000 pounds. The "sword box" for the batteries is very gracefully treated by the designer. The Riker demi-coach is another new type of vehicle. It has four seats inside and two outside for the driver and footman. Around New York City it can give a service of 25 miles on one charge. It has two motors of 2-kw each and a battery of 48 cells of 100 ampere hours. It weighs complete 4200 pounds. The battery is subdivided, part being put in front and part in the rear. Both motors are on the rear axle, one driving each wheel. The Riker theatre 'bus is again a novelty, being designed to carry twelve passengers, 20 to 25 miles on a single charge. The battery of 44 cells of 150 ampere hours is carried wholly in the boot, which has been slightly enlarged for the purpose. This vehicle has less the look of an automobile than anything else of its class, and suggests many desirable developments. The Riker mail phæton shown carries four passengers, and is fitted with one 2-kw motor and 44 cells of 90 ampere hours. It weighs 2300 pounds, has a speed up to 12 miles an hour, and can cover a maximum distance of 30 miles. The dos-a-dos has the same equipment and responds to the same general conditions. The Riker delivery wagon of the Altman type, having the battery well up in the body, is fitted with two motors of 2-kw and with 44 cells of 125 amperes. It is good for 20 miles at 12 miles an hour. The Riker vehicles are generally noteworthy for the illustration of the practice early insisted upon by their designer of separating the bodies and the running gear, and keeping them distinct.

Perhaps the greatest novelty is the Riker truck, which is expected to be in position this week, and is intended to counteract the idea that heavy work cannot be done, even on the smoother streets of a city, by electricity. This truck is equipped with two motors of from 10 to 12-hp, and with a battery of 44 cells of 250 ampere-hour capacity. It weighs complete 8,000 pounds. It is a plain platform truck with a 4-inch rear axle, and it has 4-inch solid rubber tires, although Mr. Riker believes that such vehicles will be run with solid steel tires. The batteries are in a box supported under the body, and the driver's seat is up in front with all the steering gear handy. This truck will easily carry five tons of dead weight 20 miles, and its uses are illimitable.

During the present week a Riker dog cart has been put up to be balloted for by the visitors to the show and to be awarded to the actress receiving the greatest number of votes. The competition bids fair to be very popular. The vehicle itself is a beauty. It is upholstered in English hunting scarlet, with running gear picked out in rich vermilion, and the trimmings finished in solid silver. Certainly no more "swagger" automobile has been seen this side of the Atlantic. It has two motors of three-quarters-kw each, and 24 cells of 60 ampere-hour capacity. It weighs only 1100 pounds complete, and has the ability to make 20 miles. The actress who wins this lovely automobile will be a lucky woman.

The space occupied by the Riker exhibit is one of the largest in the Gaarden and touches two of the main aisles and two of the side aisles, so that the vehicles are easy of inspection from every side. The space is handsomely fitted up, and over it hangs a large, bold sign, bearing the name Riker in multi-colored incandescent lamps.

The Libbey Glass Company's Exhibit.

One of the most attractive exhibits on the main floor is that of the Libbey Glass Company, of Toledo, Ohio, consisting of a very extensive line of cut-glass goods. In two niches at the back of the booth are shown large punch sets, one being of the "stars and stripes" pattern and a duplicate of the set presented to President McKinley. The other is called the "Electra" pattern and was made expressly for this exhibition. These niches, and in fact the entire back of the booth and the tables are covered with black velvet, so as to set off the cut glass ware to the best advantage. The

ELECTRICAL GLASS AND WARES.

niches above referred to are illuminated by hidden incandescent lamps and the effect of the light upon the cut glass articles is very attractive. The feature that is of particular interest to electrical people is the rail around the booth, which consists of electrical glass tubing set on end. These tubes are surmounted by incandescent lamp bulbs, as they are shipped from the glass works to the lamp factory, all ready for finishing. The end sections of the rail are built up of enclosed arc globes, and at each of the two front corners of the booth is a square tapering pillar on each face of which are displayed railway semaphore lenses of different sizes. The interiors of the posts contain electric lamps, the light from which shines through the white, green and red lenses, giving a very pretty effect at night. The company is represented by Mr. C. C. Oswald, of Toledo, Ohio. Mr. Oswald is distributing a neat booklet entitled "The Drama of Glass," by Kate Field, as a souvenir.

The Electroduct Exhibit.

The American Circular Loom Company of Chelsea, Mass., which concern is represented in New York by Mr. R. B. Corey, shows samples of its electroduct in the form of a pyramidal coil of tubing, the largest sized duct beginning at the bottom, the coil gradually changing through smaller diameters as the apex of the pyramid is approached. The circular pyramid is about 4 feet high and stands on a square platform. At the back of the booth is displayed the trade mark of the company, over which is an illuminated sign bearing the word "Electroduct." Mr. H. B. Kirkland, from the company's headquarters, is in attendance most of the time.

Columbia Incandescent Lamps.

The exhibit of the Columbia Incandescent Lamp Company on the main floor forms one of three made by Mr. R. B. Corey, of New York. A prominent feature of the Columbia exhibit is a large easel which supports a circular panel containing the monogram of the company in vari-colored lamps. The circumference of the circle is lighted with frosted lights and at night time the monogram forms a conspicuous and attractive feature. One of the most interesting details of the exhibit is contained in a show case at the front of the booth. The contents of the case illustrate the manufacture of the Columbia lamp, through the different stages from the bulb as it is received from the glass factory to the finished product, all ready for measurement and capping. The manufacture of the delicate filament, through every stage, is also illustrated by samples. Vials containing the compound from which filaments are made, then the raw filaments and finally the carbonized filaments form an instructive object lesson. Under two glass shades are shown the filaments of different size lamps, ready mounted to be placed in the bulb.

The Burnet Company's Exhibit.

Mr. Albert C. Jahl, manager of the electrical department of the Burnet Company, 115 Maiden Lane, New York, is representing his company at the Garden with an exhibit of a complete line of samples of its incandescent lamps in a large variety of sizes, shapes and colors, including prism lamps. These lamps are displayed on a sample board at the back of the booth, set around a revolving fan at the center which keeps the lamps cool while they are lighted. There are 176 lamps on the board, and they represent every size, style and color of lamp produced by the United Electric Improvement Co., Philadelphia, for whom the Burnet Co. is the New York State agent. The Burnet Company has the contract to furnish all of the wire and cable for the two new piers of the Cunard line of steamers. The feeder cable for these piers, of which a sample is shown at the exhibit, is lead-cased and has a conductor area of 1,000,000 cir. mils. Crescent wires and cables are shown by sample on two panels set on easels. The Cunard contract is for Crescent wires and cables.

Cutter Circuit Breakers.

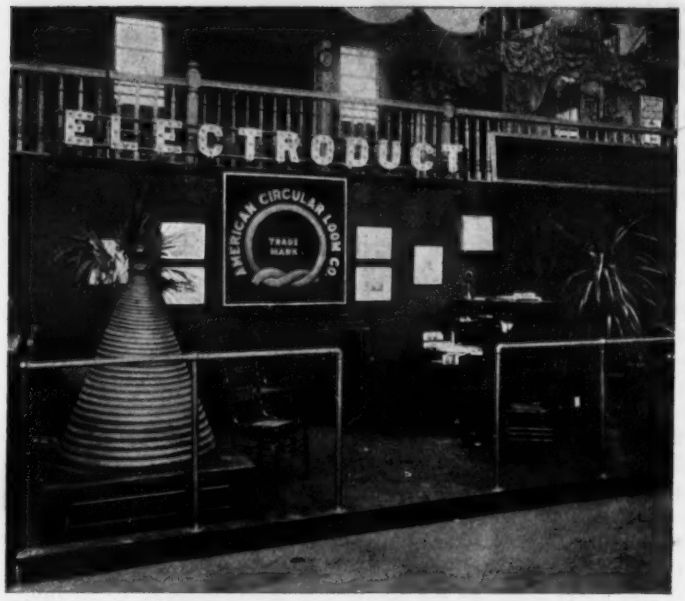
The Cutter Electrical and Manufacturing Company, of Philadelphia, makes a very attractive display of its standard circuit breakers of various capacities, and other instruments made to meet special requirements. The instruments are set on the three sides of the booth, one wall containing what are known as "freaks," that is, they are made especially for some extraordinary purpose. Among the instruments displayed are the new Q-C rheostat which has just been brought out, the instrument shown here being the first one turned out from the factory. This rheostat is of entirely new design and promises to meet with favor in the trade. Another prominent feature of the exhibit is a 1000-ampere single-pole circuit breaker with laminated contacts. By means of a toggle joint a pressure of 800 pounds is obtained which gives an extremely firm and secure contact. In breaking, the current is shunted from the copper to carbon contacts which separate with a sweeping break. A full line of circuit breakers of various sizes, and motor starters are shown; also some alternating-current circuit breakers, overload and no-voltage motor circuit breakers; an underload breaker of 400-ampere capacity for storage-battery work, a series underload and overload breaker for charging storage batteries and a circuit breaker which was designed to be operated from any distant point by means of a push button. This instrument is surmounted by a magnet which releases a trigger. It was designed for a factory in New Jersey where the proprietor himself wished to shut down at noon hour and at closing time. The series underload and overload breaker shown was made for the Brooklyn navy yard, where it is used for charging storage batteries. It releases on overload and also on the variation of voltage. The variation is adjustable between 110 and 150 volts. This breaker was designed to charge the battery at constant potential. Mr. V. C. Gilpin, 120 Liberty street, represents the Cutter Company, and the large amount of brilliantly finished copper on the numerous circuit breakers forms a very attractive exhibit.

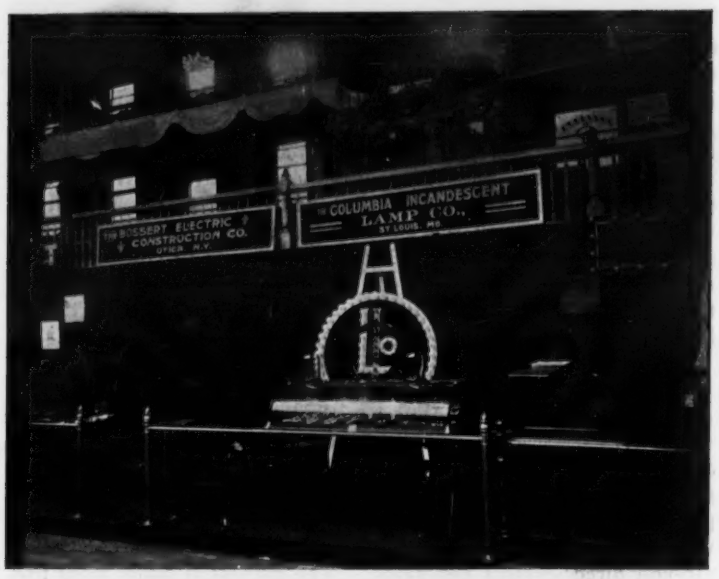
The Waverly Electric Vehicles.

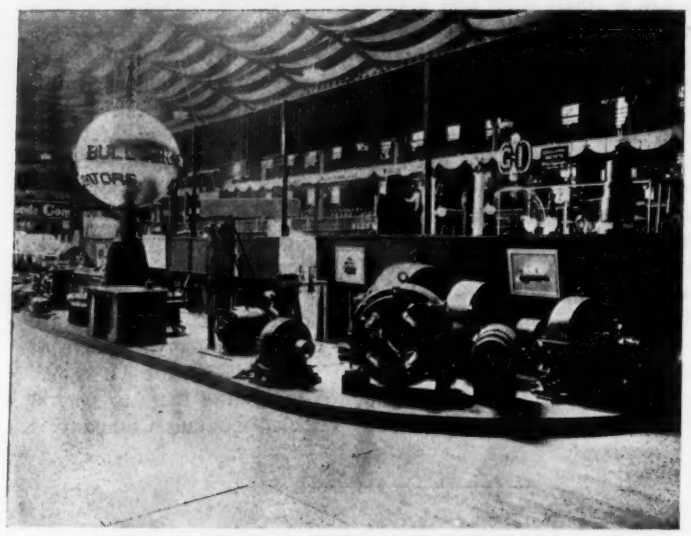
The work of the Indiana Bicycle Company, of Indianapolis, in the electric automobile field is well illustrated in the types of Waverly carriages which they have put on view at the garden, in charge of Messrs. R. M. Barwise, R. H. Hassler and F. M. Hoblett. The exhibit does not cover the entire range of their work by any means, but nevertheless serves its purpose admirably. The run-about shown weighs only 1200 pounds complete, of which the battery takes 560 pounds, in 44 cells. There is a single motor of 1½-hp with an overload capacity of 100 per cent. The radius of action is 30 to 35 miles. The steering is by a handle which is put out of the way of the riders getting in and out of the vehicle. The gears and pinions are specially cut with a view to rendering them absolutely noiseless, and there is a compensating gear on the armature shaft opposite the commutator. The stanhope shown is of the same general style and weighs 1800 pounds complete, of which the battery takes 775 pounds. The motor is single of 2½-hp and 100 per cent. overload capacity, and the vehicle will make from 40 to 45 miles on one charge. The handsome delivery wagon weighs complete 3000 pounds, and the battery 1450 pounds. The single motor is of 4-hp and a run of 40 to 60 miles can be made on one charge. The steering is effected by means of a wheel connected by worm screw, making a very positive movement. It can be set to run straight ahead or to turn in a circle with the hands off. The wheels are of wood and the tires are solid or pneumatic. One type of this delivery wagon equipped with 42 cells of battery and a 2½-hp motor is so built that the delivery body is separate from the frame proper, so that by lifting it off, the wagon becomes at once a handsome vehicle for pleasure. It has five speeds, from 3 to 12 miles an hour. This novel feature of convertibility strikes one as having many valuable elements in it.

The Bullock Electric Manufacturing Company.

The exhibit of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, which occupies a large space facing the center aisle on the main floor, is to power users one of the most instructive in the hall, since it illustrates in a practical way the direct application of electric power for the driving of machine tools. The exhibit includes four commercial machines, one 25-kw engine type generator for the Botanical Gardens, New York; a 65-hp motor, 500-rpm; a belted 10-hp motor, 1050-rpm. There is in operation a 6x5 Forbes vertical engine direct connected to a 12-kw dynamo arranged for the Bullock system of control. What may be termed the popular feature of the exhibit consists of a revolving 6-foot aluminum globe set on a column. On the surface of the globe the company's name stands out prominently in miniature incandescent lamps. The globe is propelled by air turbines and is surmounted by a small American flag, which flutters in a breeze of its own, created by a stream of air. The compressed air for these purposes is supplied by a small type N Bullock motor of 2-hp, 250-rpm, direct connected to an American gas furnace blower. The exhibit also includes various sizes of type N motors, entirely enclosed, with removable ventilating plates, back geared and for crane purposes. A very prominent and unique feature consists of direct-driven machine tools in actual operation. This is said to be the first time that machine tools direct driven by electric power have been placed on exhibition in actual operation. All of the apparatus is in operation with multiple speed controllers furnished with magnetic blow-outs and reversing gear. At the back of the space are shown photographs of conglomerate machine shops with independent motors on all tools, down to the smallest. Mr. George Bullock, and Mr. R. T. Lozier, of the Bullock Electric Company, of New York, which is the general Eastern agent for the Cincinnati concern, are in attendance, and find plenty to do in answering the inquiries of interested visitors to the exhibit.







Some of the Principal Exhibits.

Camp Vitrified Clay Conduits.

The H. B. Camp Company, of Aultman, Ohio, makes an exhibit of its vitrified clay conduits. The exhibit consists of a 20-foot span of sixteen ducts cemented together forming a square section which is self-supporting between the brick manholes at the ends. Samples of ducts of different sizes, from 2 to 5 inches, four-way branches, curves and distributing boxes are shown. The booth is tastefully draped at the back in red and blue fabric in vertical pleats. Mr. Louis W. Camp, of Akron, Ohio, son of Mr. H. B. Camp, is in charge of the exhibit, and Mr. A. L. Daniels is in attendance part of the time. Mr. Camp reports that his company recently sold 700,000 feet of duct to go to Antwerp, Belgium, and that its foreign trade is rapidly expanding. Mr. Camp is distributing lead pencils as souvenirs.

The Wagner Electric Manufacturing Company.

The Wagner Electric Manufacturing Company, of St. Louis, has an exhibit of its apparatus which has special interest to central station managers, especially those who are looking for a way to improve their day load. The exhibit comprises a 7½-hp 60-cycle 110-volt single-phase alternating-current motor which operates a 6-kw 110-volt direct-current generator. The current is taken from this generator through a switchboard which is mounted with direct-current voltmeters and ammeters and alternating-current ammeters and volt-meters, and an indicating wattmeter for the purpose of registering the current supplied to an exhaust fan driven directly by a 110-vole motor. A 60-cycle 110-volt singe-phase motor belted to a ventilating fan is also shown. The company is about to place upon the market some switches which have some new and valuable features. Samples of these are also on exhibition. The exhibit includes a large unit of the company's high-tension transmission transformers and a full line of standard lighting and motor transformers. The company's new type of switchboard instrument is also on exhibition. The interests of the company are looked after by Mr. John C. Creswell of the Philadelphia office.

The Rochester Time-Recorder.

The Willard & Frick Manufacturing Company, of Rochester, N. Y., has an exhibit of its time-keeping system, which is extensively used in factories and by other concerns employing a large number of hands. It gives a weekly, bi-weekly or semi-monthly record, all on one card. An important feature of the system is that each employe keeps his own time, thus dispensing with the services of a time-keeper. The card record can be seen at all times, and as it is accurate it avoids any possibility of dispute. By the use of this system a vast amount of labor is saved in the office and time in the factory or store. The fundamental idea of the system is to obtain a just, simple and reliable record of the arrival and departure of the employes. It is stated that this system has been found to be so reliable and accurate that large concerns employing as many as 2000 or 3000 men pay entirely from the card records, without any other book-keeping. The cards enable work to be performed in one-sixth of the time required when clerical labor is employed. The Rochester Time Recorder System was awarded the John Scott medal last year on the recommendation of the Franklin Institute of Philadelphia. Mr. F. A. Frick, of the company, is looking after its interests at the exhibition.

American Electric Vehicle Company.

The rivalry between the East and West in the automobile field is interestingly illustrated at the garden. There is so much carriage building and buggy-making out west, good results in the new department are confidently expected from that quarter, and it must be said that the electrical exhibition presents western effort in an extremely encouraging and hopeful aspect, not only a large part of the automobile space being occupied by western manufacturers, but the types and varieties brought to notice are full of interest, especially in their successful striving for lightness and elegance of appearance with actual sturdiness of construction.

The American Electric Vehicle Company, of Chicago, show two handsome types of motor vehicles, one a delivery wagon and the other a Stanhope. Both have been in actual operation in Chicago for over a year but in their new coat of paint form one of the most attractive parts of the electric show. The booth is well furnished on the main floor, northeast, is filled with growing palms and presents a very inviting appearance.

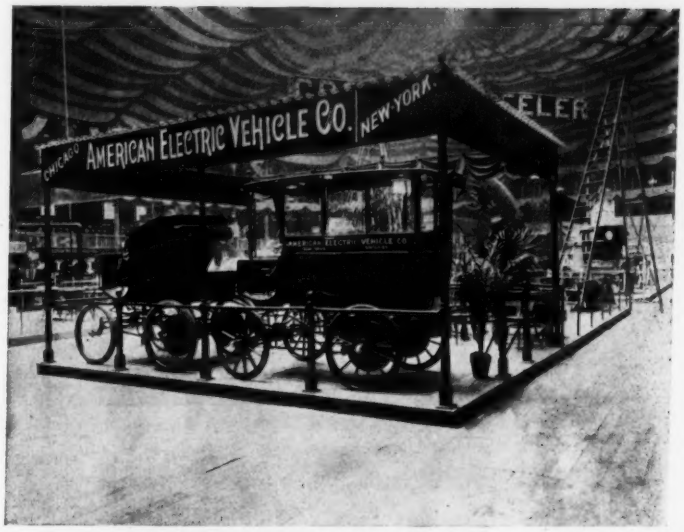
During the present week a later type of vehicle will be exhibited—a runabout buggy which is now en route from the factory. The circular distributed entitled the "20th Century Movement" shows some illustrations of different wagons and contains some interesting news relative to motor vehicles. The exhibit is in charge of H. G. Osburn, engineer of the company.

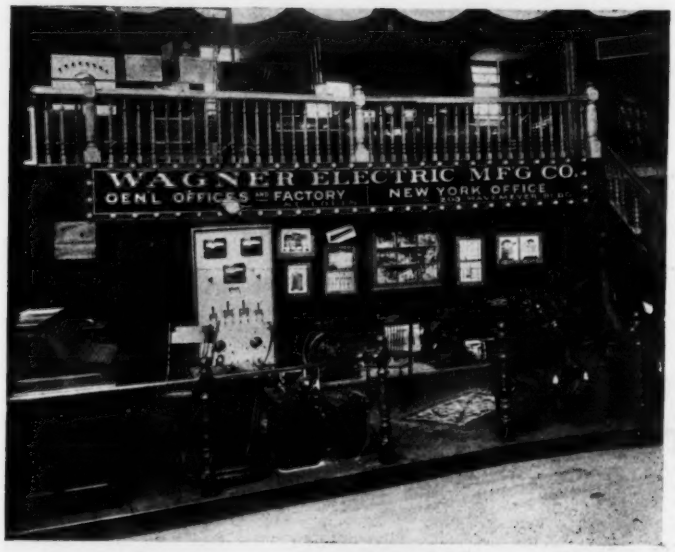
Exhibit of American Vitrified Conduit Company.

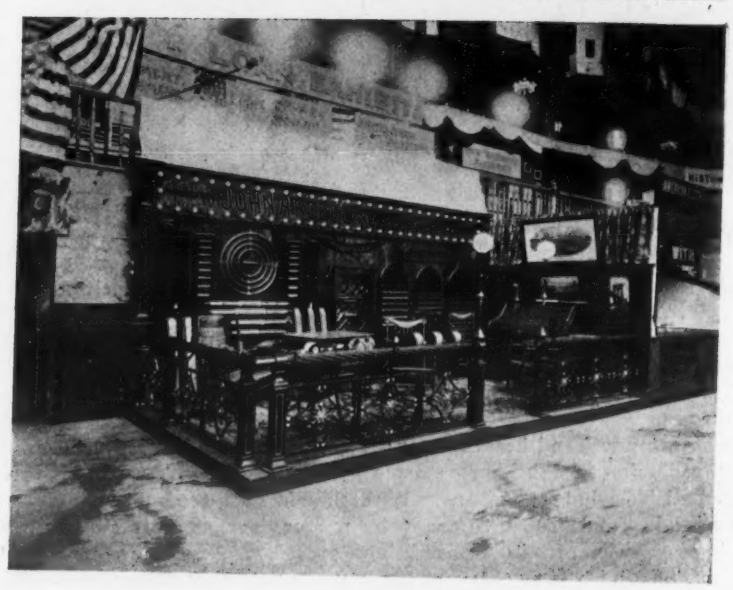
The American Vitrified Conduit Company has arranged a very attractive and instructive exhibit at the electrical exhibition, showing samples of its multiple duct conduits from two to sixteen ducts, of which it makes a distinct specialty. All its multiple duct conduits use dowel pins for alignment in making joints, assuring a positive and true joint and doing away with any necessity of using mandrils in laying conduits. The company's various types of single duct conduits, of which it shows several, are of the self-centering or socketing type. A very instructive part of the exhibit is the subway system, laid out in miniature, showing a manhole built of the company's new type of manhole brick, with a special arch for the top and covered with the McGregor noiseless manhole frame and cover made by the McGregor Manufacturing Company, of New York. Running out from this manhole are two lines of conduits, on the bottom being the feeder conduits or trunk line ducts made of various size multiplex duct sections, and running over them are a single duct and a three-duct section showing the distributing system into which are introduced the company's various types of distributing boxes for service connections. This company has developed a complete distributing system for electric light, power and telephone companies and has designed all the detail parts to make a complete model system. It is issuing a new catalogue, gotten up in an attractive and artistic manner, showing its various types of conduits and methods for using them, and giving complete details of its distributing system, manholes, etc.; illustrating also some of the work on some of the leading contracts which the company has on hand at Providence, Baltimore, New Orleans, Philadelphia, Savannah, Springfield, Mass., and other places. In connection with the American Vitrified Conduit Company's exhibit are also shown junction boxes to be used in the Company's system of distributing or service boxes. These are made by the D. & W. Fuse Company, of Providence, which is furnishing them to several of the systems which the American Vitrified Conduit Company is now installing.

Roebling Wires and Cables.

The John A. Roebling's Sons Company, Trenton, N. J., makes a very complete display of samples of all its wire products, and the list is a long one. It includes bare wires of all kinds in copper, from the largest trolley wire down to No. 36 gauge; office and magnet wires in great variety, electric light cord, etc., etc. The display is mainly in the form of samples, although there are several articles of special interest which constitute prominent features in themselves. For instance, there are several 300-pound copper ingots, each of which contains enough material from which may be drawn 75 miles of No. 36 wire. A popular feature is a case containing samples of the last Commercial cable, which include the large shore ends, the intermediate sections and finally the deep-sea section. The conductor for this cable was furnished by the Roebling company. An object of special interest to railway men is the special splice of the large three-phase cable for the Metropolitan Street Railway company. This cable is made up of three 0000 wires, and will be used for the transmission of high-tension current over the company's system. The splice is quite compact, the only visible evidence of its existence being an enlargement about a foot long of the lead casing. Another popular attraction of this exhibit is some pieces of the wire rigging of the steamer "Merrimac," which was sunk by Hobson in Santiago harbor. This rigging was manufactured by the Roebling's company. The general display includes wire ropes of iron and steel, galvanized and flat, and telephone terminal heads. On a sample board at the back of the booth is a series of concentric rings of copper cable to illustrate how the company lays up the copper wires in cable-making. There are also shown samples of telephone paper-insulated cables, containing 120 pairs of wires and 100 pairs. The railing around the booth is itself an attractive







Some of The Principal Exhibits.

feature. It is of wrought iron and the top consists of a wire rope 10 inches in circumference. This rope has a breaking strain of 550 tons. Samples of Columbia and flexible rail bonds, which are manufactured by the Roebling's Company, together with one of the presses for putting the bonds in place and fastening them, are also shown. The company's interests are looked after by Mr. R. M. Cockey, A. M. Whitaker, G. W. Swan and F. W. Harrington. Manager H. L. Shippy visits the booth frequently.

Telephony at the Garden.

One of the most tasteful and at the same time one of the most useful exhibits in the garden is that of the New York Telephone Company, who occupy the same triangular corner fronting the Madison avenue entrance as they had last year. The first thing that catches the eye is the "Sign of the Bell," a lofty arch within which hangs a big blue bell upon which picked out in letters and lamps is the now famous advice: "Don't travel; telephone." The whole space is upholstered in deep blue and white, from the rails to the back board and the name of the company over all. At the front, under the bell is placed an interior exchange board with forty drops connected up, serving as an exchange for the exhibition, the telephones being located in the leading exhibits all over the building. Operators are in charge all the time, as well as uniformed attendants, who answer questions and distribute some very effective literature. Behind this part are grouped four silence booths which are at the free disposal of the public, either in the way of getting an idea of the way the work of an exchange is done right through from speaker to speaker, or for regular business and social intercourse. The exhibit is a great centre of attraction.

In addition to this, the New York Telephone Company has placed a transmitter with horn over the Estey organ driven by electricity in the west balcony, and the loud speaking receiver with double horns is hung up in the Mimic Theatre several yards away in the basement. There the music from the organ is distinctly audible. During the present week, the receiving theatrophone is being connected up with some of the theatres so as to receive vocal

EXHIBITION TELEPHONE EXCHANGE.

and instrumental music from them. Last year individual receivers were used, and they were too few owing to the rush to secure them. Now a large number of people can stand or sit under the loud speaking theatrophone, which has also the advantage of being thus placed in a quiet corner of the show instead of on the noisy main floor.

Another novel and beautiful constituent part of the exhibit is the Bell radiophone, with improvements by Mr. Hayes, of the American Bell Telephone Company. With the aid of a general electric searchlight and an eighteen-inch mirror some most interesting experiments in transmitting speech and music on a beam of light have been made, and when the delicate organism is rightly adjusted, the results in transmitting across the hall are surprisingly good. The public will probably participate fully this week in the results obtained.

The telephone exhibit, etc., has been organized by Mr. Herbert Laws Webb, and is under the general charge of W. E. Huntington and S. D. Brewster.

Differential Rate Meter.

BY LYMAN C. REED.

THE origin of the modern practice of differential charging for current consumed, arose from the assumption that the consumer's load line corresponded in a measure with the load line of the central station. It is manifest if the consumer used a fixed amount of current each hour of the 24, no meter would be needed or a differential rate charged. The needs of the consumer are ever subject to change, hence a meter is preferable to a flat rate. A differential rate on a meter basis is still an advance on the usual flat meter rate, but difficulty has hitherto been found in obtaining in a cheap way the load curve of the consumer's burning. It is essential in fixing a differential rate to have a load curve of the consumer's burning at hand to note the time of his local peak and minimum

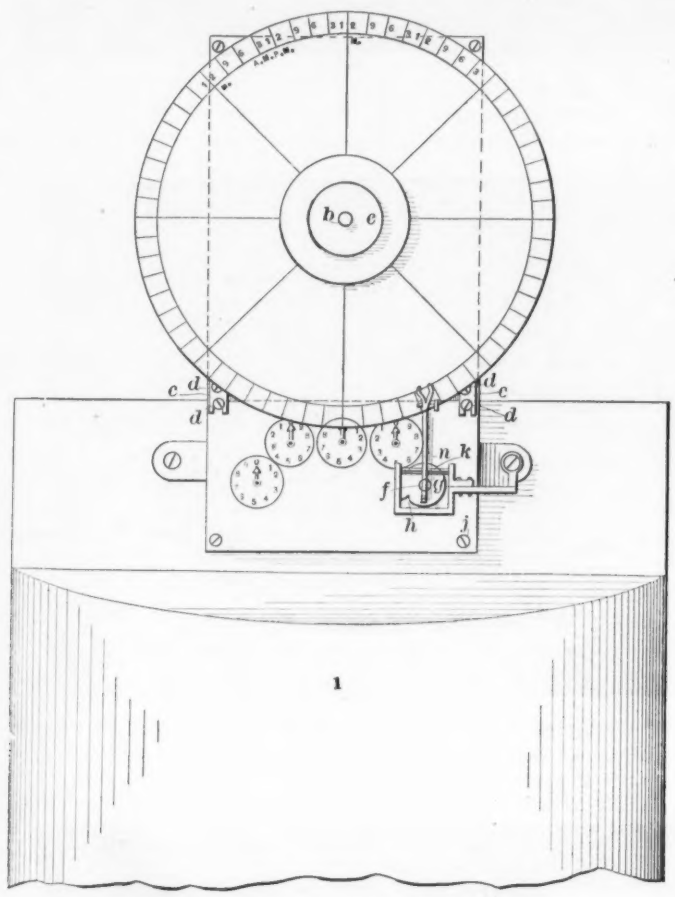


FIG. I.—FRONT ELEVATION OF WATTMETER.

burning and the duration of each, also the hours in which no light is consumed.

The leading systems of to-day are the "Wright Demand," two-rate meter, and the ratio method of apportioning the total amount consumed, to each lamp installed, at a certain rate per kilowatt up to a fixed number of kilowatts, the remainder left being charged for at a lower rate.

The "Wright Demand" system for differential charging seems to have met with the most general favor, since each consumer is charged according to the cost of supplying his demand on the plant, with a profit added. The consumer's demand on the plant is ascertained by a recording ammeter, which indicates that at some period during the month a certain maximum quantity of current was consumed. It is impossible to tell at what time this maximum current was consumed or how long it remained on, whether for five minutes or one hour. Such a demand meter only furnishes a very rough method for differential charging, as the maximum demand may have occurred at a time when it benefited the load curve of the plant instead of augmenting the peak.

Nearly all current sold is measured by wattmeters, and the total amount consumed is ascertained at regular fixed intervals. The total current consumed for one month being thus obtained, the question arises, At what rate should this current be charged? It is this question that the three systems mentioned above attempt to solve, but, as is readily seen, only an approximation is reached by any one of the three.

A device that would take the total number of watt-hours registered for a given period and break it up into its component parts, telling how long the maximum load was on, how long the minimum, and also when no lights were burned at all, each day, gives a complete load curve of the consumer and furnishes a perfect basis for differential charging.

Such a device we will proceed to describe, giving three views

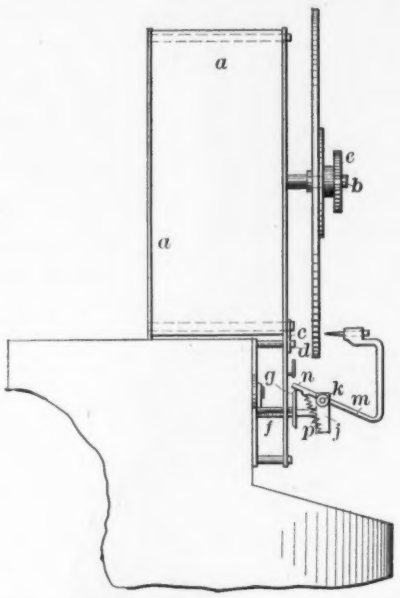


FIG. 2.—SIDE ELEVATION.

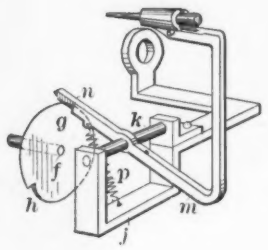


FIG. 3.—DETAIL PERSPECTIVE VIEW.

and also some load curves obtained from an instrument in actual service. The object of the device is to show through the medium of recording mechanism the differences in the load of any measuring and recording meter with regard to the time in which a certain quantity of fluid has been registered. The purpose is to indicate visibly whether the given quantity has been registered uniformly or variably; if variably, the hours, or between what hours the variation occurred. For example, if a wattmeter registers 5000 watt-hours in twenty-four hours, it is desirable to know whether this quantity has been registered at a uniform or a variable rate, and if variable, between what hours the variation in load consumed occurred. If 3000 watt-hours have been registered between 4:00 p. m. and 9:00 p. m., and the remainder during the rest of the twenty-four hours, the information is desirable and imporatnt for determining the basis of charge for the quantity of current consumed. The device is not limited to the use of electric meters entirely, but will operate on any meter which by means of a registering train records the energy passing through it.

The manner in which the objects set forth are attained will be better illustrated by referring to Fig. 1, which shows a broken front elevation of a wattmeter with the device in operative connection therewith, Fig. 2 being a broken side elevation of the same. Fig. 3 is a detail perspective view of the marking carrier on which the marker is mounted, showing also the detachable bracket or frame for supporting the carrier, and the rotary cam disk or wheel, which serves to actuate the carrier at certain intervals.

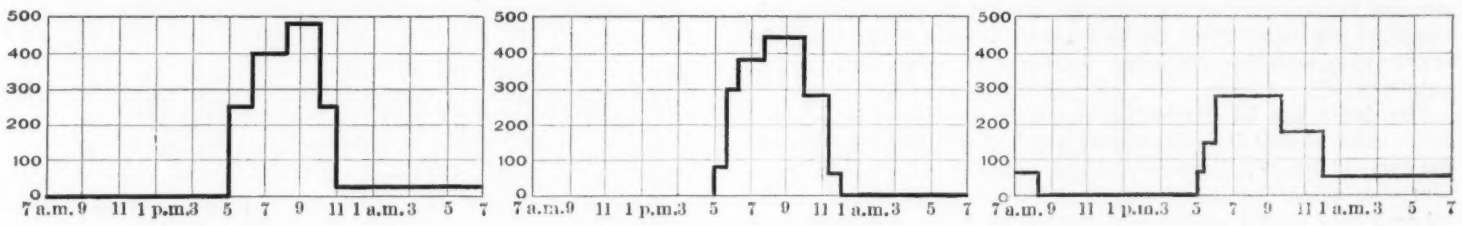
Fig. 1 indicates a T.-H. wattmeter, having a clock frame, *a*, containing an eight-day, 30-day, or a self-winding movement rotating arbor *b*, on which is mounted a dial subdivided into eight-day or 30-day divisions, as the case may be, by radial lines, each designed to indicate twenty-four hours. Short radial lines further subdivide this space into three-hour divisions. As the diagram shown indicates an eight-day clock movement, the description will be confined to this form for the purposes of the present discussion

The clock movement is attached by straps, *c* and *d*, to the meter dial as shown. The chart dial is detachably secured to its arbor by washer 10 and a thumb screw, *e*, allowing the chart to be easily replaced by a new one. The shaft, *f* (Fig. 2), which usually carries the index pointer for the initial or primary dial, extends from the point of the dial plate a sufficient distance to carry a disk-shaped cam, *g*, the cam portion of which is in the form of a pheripheral notch, having a rounded edge, as shown at *h* (Fig. 1). In front of the cam disk is arranged the removable bracket, *j*, secured to the meter frame by a screw which is also used to secure the dial to the meter frame. The bracket, *j*, supports a small oscillating spindle, *k*, at the centre of which is mounted an oscillating pencil or stylus, shaped as shown in Figs. 2 and 3.

The lower arm, *m*, is mounted between its front and rear end portions on the spindle in such manner as to allow a tail piece, *n*, to extend towards the dial plate and bear on the cam *g* as shown. The tail piece, *n*, is secured in this position by a spring, *p*, for the purpose of holding it in contact with the periphery of the cam disk, causing it to spring into the notch once for every revolution of the cam.

The point of the pencil is arranged the proper distance from the chart so that a dot is made on the chart for every revolution of the cam. The cam and tail piece are both brought to knife edges to reduce friction, and the tension of the spring is made very slight. The cam can be provided with a number of notches and be made to represent any desirable unit less than that represented by one complete revolution of the cam. The working of the device should now be obvious without any further explanation, as it will be seen that a fixed unit is recorded on the chart at intervals, the distance between the dots being the time consumed in recording the unit. It will be seen that this instrument indicates also the time of day at which the unit recorded was consumed. Should the meter stop while the pencil point is in contact with the disk or ribbon, a line is marked which indicates that no current was consumed for the period covered by the line. The stoppage of the line indicates the time at which the current was again turned on. The reading of the charts becomes readily familiar in a short while, a quick succession of dots indicating a heavy load, dots at long intervals showing light load. A load curve is easily plotted by making the hours the ordinates and the abscissae the units into which the cam disk is divided. The curves shown in Figs. 4, 5 and 6 were obtained in this manner.

The disk-shaped cam takes the place of the initial dial hand and one of the notches (if there is more than one) is selected to represent the pointer. One of the possible objections which might be raised to an attachment of this kind is that it adds to the frictional load of the meter. By actual trial the frictional load added was found to be so small as to be entirely unappreciable on the smallest load of one 16-cp lamp, proving that the accuracy of the meter is in no wise affected.



FIGS. 4, 5 AND 6.—LOAD CURVES.

Some load curves obtained from a private residence illustrate admirably the nicety with which the amount of light consumed at different hours can be obtained. The curves given here were plotted directly from charts obtained from a residence containing 21 16-cp lamps. On meters of large capacity it is desirable to have a number of notches in the disk dividing it into, say 500-watt-hour units, the number of notches being readily ascertained by noting the constant of the meter. For example, a meter with constant ½ would need one notch to give a 500-watt-hour unit. A meter of this

size if used on five to ten lights should be provided with a cam giving 50 or 100-watt-hour units, the units being of 6 or 12 minutes duration if a full load of 10 lights were being burned. The load curves given in Figs. 4, 5 and 6 were obtained from a meter having for its constant unity, the cam being divided into 250-watt-hour divisions.

A few words relative to the actual operation of this device by the central station are not considered out of place. The clock used would be preferably a self-winding one operated by current from the service connection. For the rotating disk may be substituted a ribbon, such as those used on steam gauges, having the days, hours, etc., marked on it. The ribbon can be of indefinite length—long enough we will say to last six months, the divisions in hours, and days being dated so as to correspond to the time kept by the clock. At the visit of the meter reader the ribbon chart used for the month is removed and returned to the office along with the reading. It may be arranged so that a carbon copy of the ribbon chart can be taken at the same time, and given to the consumer if desired. After several months, if the load curve remained proportionately the same, the clock attachment could be removed, as the rate by that time could be obtained from the curves furnished for several months.

A diagrammatic chart which shows exactly when and for how long the consumer's lights were burned according to the hour and day of the month, would be of untold importance in settling disputed bills. It would be impossible for a consumer to claim that no light was used after certain hours if the chart showed that such was not the case, and on the consumer's side the chart would be of great advantage in making him aware of any waste. The percentage due to error from all causes in a well-managed meter department falls below ⅓ of 1 per cent., but the disputed bills range from 2 to 5 per cent. The disputes are due to a lack of knowledge of the amount of light consumed, or to a desire to get a rebate or make a delay in payment. It is this class of complaints which could be most readily and effectually settled by means of the chart, showing the exact time of the burning of the lights.

The attachment is inexpensive as reliable clock movements are obtainable at a low figure, and the other parts of the apparatus are all detachable and simple in construction.

Thus we have a simple method of obtaining a correct basis for differential rating which in point of simplicity and correctness of results, is far in advance of any of the present systems. The advantage of having the device a simple attachment is evident, since no extra wiring has to be done, and no extra space is required except a vertical distance of four inches. The only change needed in adapting it to the present type of wattmeter is a cover tall enough to enclose the attachment in the same comparment with the meter. The parts are few and simple, the action positive in its nature.

The universal application of this device to all forms of gas, water or oil meters which indicate by means of dials is of great value in ascertaining the amount consumed for a given period. As an illustration of its usefulness on a water meter, suppose the device was attached to the meter on the feed pipe of a set of boilers. The efficiency of the boilers and engines under different loads would be readily obtainable by comparing the water curve with the engine output curve.

The device can be attached to the main wattmeters in a plant, and a curve plotted from the results which should tally closely with the curve obtained by ampere readings, only the curve would represent watt output instead of ampere output. A meter placed on the oil tank in a central station with this device attached would check up the use of oil on the different watches, any undue waste being in that way traceable to its source.

The many and varied uses to which this instrument may be applied are too numerous to mention, but its special adaptability lies in obtaining the load curve of the consumer's meter.

The "A. B." Alternating Enclosed Arc Lamp.

The lamp illustrated herewith is, as will be recognized, of the enclosed arc type, and is made for alternating current circuits. The case is of solid, hard rolled sheet copper, which can be made very ornamental for inside use. The same lamp can be used out doors, and maintain its good appearance, since the case is practically indestructible.

This lamp operates on a voltage of 100 to 125, taking from 5 to 7½ amperes of current, and it can be adjusted to operate on either 7200 or 16,000 alternations.

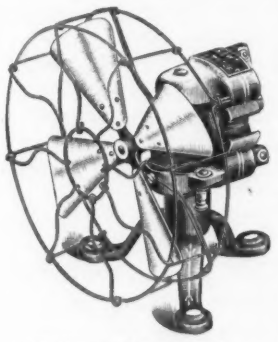
The Adams-Bagnall Electric Company, Cleveland, Ohio, states

ALTERNATING ENCLOSED ARC LAMP.

that it has spent many months in the development of this lamp, and is now prepared to guarantee its successful operation.

A Battery Fan.

As the season for the use of electric fans is at hand, the machine illustrated herewith will no doubt be of interest to the trade in general and to those looking about for one of these air coolers. The motor is of the single-bearing type mounted on a neat tripod. The special features of the fan are its noiseless operation and neat appearance. The noiselessness is the result of several new devices adopted by the maker, the Kent Manufacturing Company, of Worcester, Mass. The style and finish of the machine are of the first quality. The fan is wound for 2 to 8 volts and consumes from 1½ to 1¾ amperes. It may be run by means of a battery giving the necessary current. The Kent Company has for several years been making battery fans, and this year's machine, it is stated, is superior to all its predecessors.



KENT BATTERY FAN.

Cutter's Wire Rope Insulator.

The use of flexible wire rope for hoisting arc lamps has occasionally led to trouble by the readiness with which the rope will conduct any stray current from the lamp frame to the terminal of the rope. The rope end is usually rather low, so that it is easy for any one to touch it and to thereby get a shock in case the circuit happens to be grounded to the lamp frame and from it to the hoisting rope. This fact also makes it risky for the trimmer to lower the lamp on a live circuit when that becomes necessary, and with the higher voltages now in use or arc circuits, such risk is greatly increased.

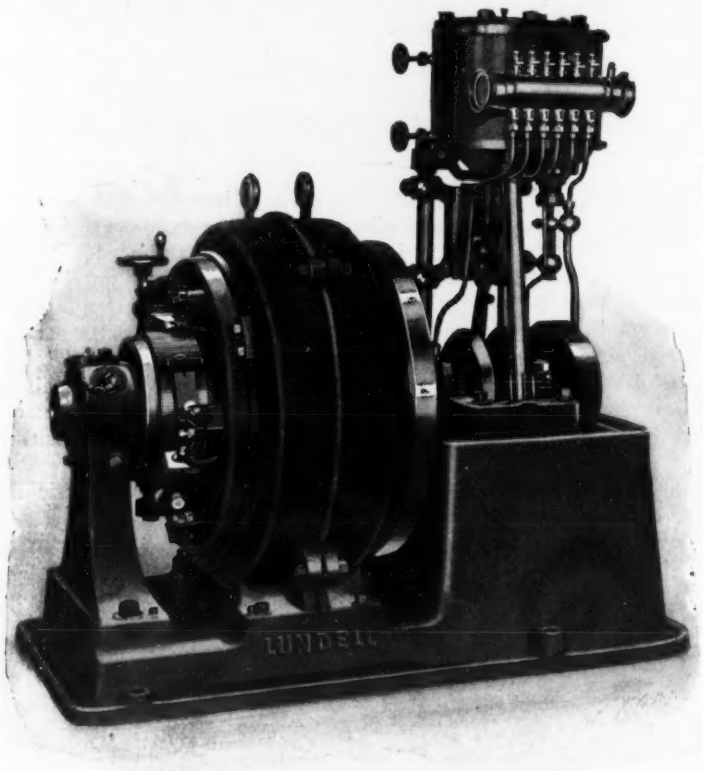
To overcome this the George Cutter Company, of Chicago, has

WIRE ROPE INSULATOR.

devised an insulating link which can readily be looped into the hoisting rope just outside of the pole pulley, and which will then insulate the lower end of the rope and obviate danger should the circuit become grounded in wet weather. The new device consists of a steel link with hard rubber moulded around it, and with steel ferrules to keep the cable from cutting into the rubber. It is being marketed as "Cutter's Wire Rope Insulator," and is said to be meeting with the cordial approval of those who already have it in use.

A Lundell Direct Connected Generator Outfit.

The accompanying illustration shows a Lundell generator driven by direct connection to a Forbes marine type engine. The size of the generator shown here is nominally of 8-kw capacity, having a speed of 500 r. p. m. and capable of operating an equipment of 160 16-cp lamps at full candle power. The set from which this



DIRECT CONNECTED GENERATOR OUTFIT.

photograph was made has been installed on the steam yacht "Postmaster General," now doing duty in New York Harbor. When the plant was installed, an exhaustive test was made which showed that the apparatus is capable of developing 10.8-kw, supplying 216 lamps.

As the primary qualities in a direct-connected set for marine work, especially by yachts and similar classes of vessels, is compactness, light weight, ability to stand overloads and accessibility, it will be seen that these points are met when it is mentioned that the total weight of this set is 1050 lbs., or about ⅛ lb. per watt output. The amount of space taken is small, being 27 inches wide by 6 feet 2 inches long, the height being 38 inches. One particular feature of this set is that the centre of gravity is low, thus insuring a great degree of stability. The ability of the generator to carry an overload without sparking at the brushes, is due to the series-wound armature, and the use of a single-field coil, which is a peculiar feature of Lundell generators. This single coil magnetizes all the different field poles to the same degree of intensity. The armature is well ventilated. The commutator is large in diameter and breadth of face, which allows it to run cool. The magnetic circuit is very short, requiring a minimum of copper to energize the field, thus conducing to high efficiency.

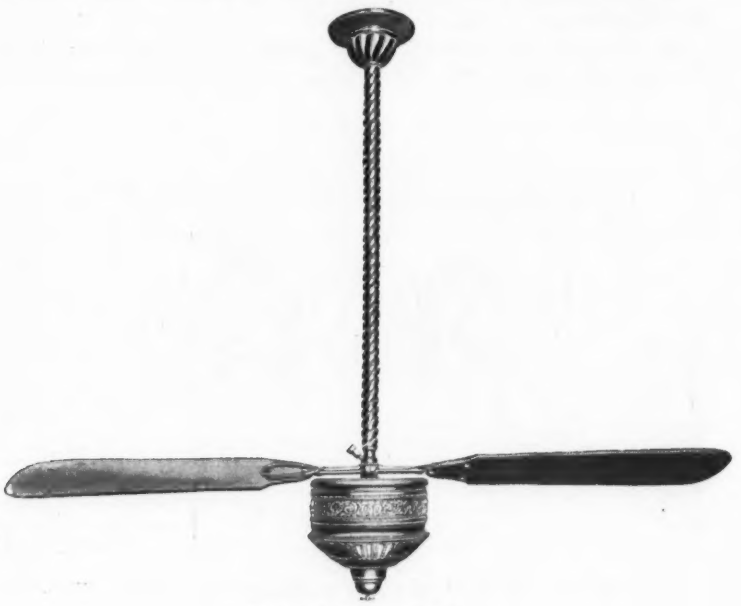
The details of both generator and engine seem to be carefully worked out; the engine runs smoothly and without vibration. The manufacturers claim that the generator will meet the most exact specifications in regard to heating, sparking limits, and efficiency.

The Sprague Electric Company, 20 Broad Street, New York, advises us that it is supplying these direct-connected types in the following sizes: 8-kw, 16-kw and 32-kw, generating current for 160, 320, 360 and 640 lamps respectively. The company also states that it has found it necessary to operate its factory on an average of fifteen hours a day in order to meet the increased demand for motors and generators.

New Paragon Ceiling Fan.

The Paragon Fan & Motor Company owned by the General Incandescent Arc Light Company, has just put on the market a new form of Paragon ceiling fan which embodies many desirable features and improvements.

The armature shaft is hollow, the fan blades being carried at the upper end and the lower end running on ball bearings situated in the frame of the machine. The armature is of the ironclad, drum-wound type. The commutator is made of hard drawn copper bars, and is parallel with the armature shaft, the brushes fitting against the commutator in a horizontal position, as in any standard motor, and not in a vertical position as in some types of the ceiling fan motors in which a face plate commutator is employed. The advantage of this is said to be that very much better commutator and brush devices are possible and that this is an extremely important



PARAGON CEILING FAN.

point, since most of the troubles that develop in any type of fan motor are commutator troubles. The fans are fitted with a snap switch at the bottom, by which they can be turned on or off. They run at a speed of 175 revolutions per minute, and will run continuously without heating above forty degrees Centigrade. Some of them can be seen in operation at the "G. I." exhibit in Madison Square Garden.

The K. A. K. Electric Railway System.

The accompanying illustrations show some of the details of the K. A. K. railway system of Messrs. Krotz, Allen & Kelley of Springfield, Ohio. This is a conduit system, and it is designed for application in the transformation of steam to electric railways, for elevated railways and for street traction.

The accompanying Figs. 1, 2, 3 and 4 show the application of the system to street railways. In Fig. 1, *C* is the trolley conducting rail, *A* the supporting yoke and D_8 ordinary gas pipe supported by insulators D^1. In the gas pipe are placed the feeders *E*, which ex-

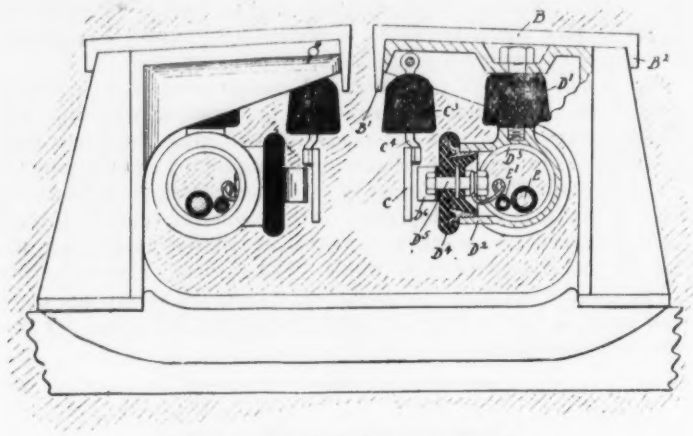


FIG. 1.—CROSS-SECTION OF CONDUIT.

tend the entire length of the track; connected to these at suitable distances by means of switches and fuses enclosed in water-tight boxes, are auxiliary feeders E^1, each of sufficient size to feed independent section of the trolley rail *C*, of a length equal to the distance between the switch boxes. This admits the cutting out of any section of conductors, *C*, either automatically for cause, or when necessary for inspection, without interfering with the operation of the line.

Contact between the supplementary feeders E^1, and the conductors *D*, is made every 24 feet, by bolts D^5, which pass through the insulators D^4, and enter the pipe through the *T* couplings, D^3. The trolley conductor *C* is of steel presenting a wide surface for contact with the trolley shoe. In Fig. 2, the trolley rails are shown suspended from insulator hangers C^3, being hung at a distance of $\frac{3}{8}$ inch from spring contacts D^6, which are connected electrically to the supplementary wire.

In the application of the K. A. K. system to street railways, there are manholes every 300 or 500 feet, where the sections end and

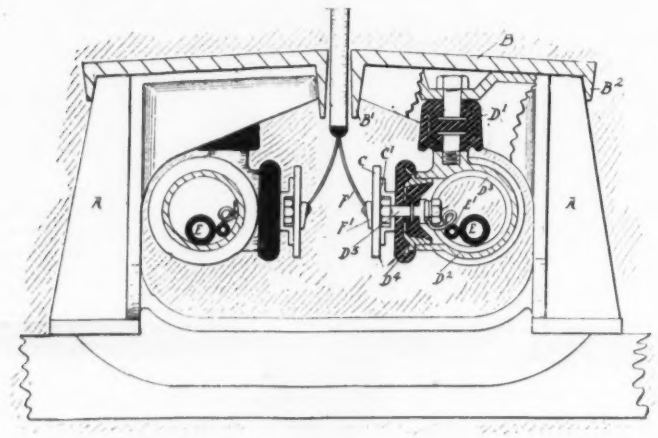
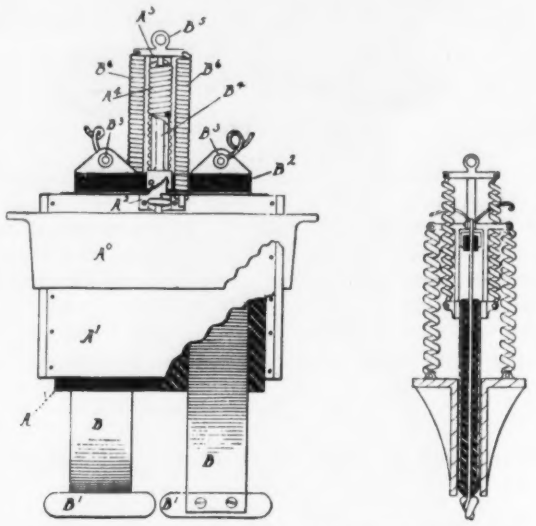


FIG. 2.—SECTION CONDUIT SHOWING TROLLEY RAIL SUSPENSION.

where the fuse switches and fuse boxes are placed, connection is at these points being also made with the sewer.

In Figs. 3 and 4, the trolley shoe is shown in detail, *B B* are two springs made of flat steel or spring brass. On their lower ends are attached cast iron shoes for making contact with the trolley rail *C*, as shown in Fig. 1. These shoes can readily be replaced at a trifling expense. The springs *B B*, one for the positive and one for the negative trolley conductor, are curved in opposite directions at the bottom and pass through and are supported in insulating material *A*, which is in turn protected and supported by the steam covering A^1, which in turn is fitted loosely in the base, A^6 fastened permanently to the tracks.

The springs *B B*, which are fastened together at the top by the insulating fibre B^2, pass loosely through the insulation of the casing and are held down by the springs B^6 which are attached to the post and cross bar B^4 and B^5. The casing is in turn held down by heavier springs attached to the standard and the base. Binding posts are provided at the upper end of the springs *B*, to which the wires leading to the motors are attached. To raise the trolley from



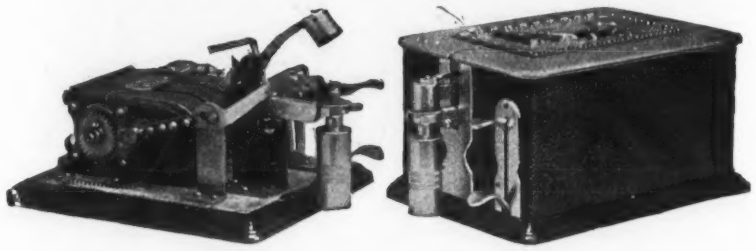
FIGS. 3 AND 4.—DETAILS OF TROLLEY SHOE.

the slot, a lever on the platform attached in a proper manner to the cross bar B^5 raises by a single pull of the motorman first, the springs *B*, drawing the shoes away from the trolley conductor *C*, and causing them to come together, as shown in Fig. 4, when they may be removed from the slot.

The "Perfecto" Electric Lighter and Cutter.

The "Perfecto" cigar lighter and cutter, illustrated herewith, is claimed to possess a positive advantage over the usual type of electric cigar lighters, in that it is portable and self-contained. There are no batteries to look after and no connection with an electric light circuit is necessary, in order to get a supply of current. The box contains its own generator, in the form of a magneto, the armature of which is set in motion by means of gearing actuated by a small lever at the front of the box. The resulting spark ignites the torch, which may then be removed from the hook. On replacing the torch, a cap comes down automatically and extinguishes the flame.

This device, which is manufactured by the Abbott Electric &



THE "PERFECTO" CIGAR LIGHTER.

Manufacturing Company, 74 Frankfort street, Cleveland, Ohio, is well made, and finished in various styles to suit individual fancies, the box being trimmed in polished nickel or old copper. In the construction of the machine the best materials are used, and with ordinary care it should last indefinitely. A gasoline torch is used, the electric spark igniting the vapor.

NEWS OF THE WEEK.

Financial Intelligence.

INCREASE OF ELECTRIC VEHICLE STOCK.—The Electric Vehicle Company has filed papers with the Secretary of State of New Jersey, increasing its capital stock from $10,000,000 to $12,000,000.

ELECTRIC VEHICLES IN BOSTON.—Papers were recorded last week transferring the Cyclorama building from the Gardiner estate to the New England Electric Vehicle Transportation Company for $163,350. It is to be a central stable or depot.

WESTINGHOUSE COPPER.—A Pittsburg paper states that Mr. Westinghouse is the owner of an Arizona copper mine, and that the Westinghouse Electric & Mfg. Co. will not be dependent upon the new combination for its supplies and will not be affected by any prices it may make.

GENERAL ELECTRIC COMMON.—There is a report that dividends are likely to be started on the General Electric common stock within a very short time, possibly within a week. Good authority has it that a beginning will be made at a 5 per cent. rate. There are those who think that some extra dividend will be forthcoming.

SEATTLE ELECTRIC ROADS.—A consolidation of six of the eight Seattle (Wash.) street railway companies has been effected. C. A. Stone and L. J. Webster, representing Boston capitalists, are at the head of the new organization, which will be incorporated either in New Jersey or New York. The capital stock will be $5,000,000. The company will ask for a 40-year franchise of the city council.

GENERAL ELECTRIC COMPANY'S MEETING.—The annual meeting of the stockholders of the General Electric Company was held at the company's offices at Schenectady, N. Y., May 9. The number of shares voted was 135,412, out of a total of 208,272. The old board of directors was re-elected, excepting J. P. Ord, who replaces F. S. Hastings, retired. The board is now composed as follows: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., C. H. Coster, Thomas A. Edison, George P. Gardner, Eugene Griffin, J. P. Ord, Henry L. Higginson, J. Pierpont Morgan, Robert Treat Paine, 2d, and George Foster Peabody. The new board of directors met and adjourned, to meet in three weeks.

BIG PHILADELPHIA CONSOLIDATION.—A special despatch from Philadelphia of May 10 says: There was a rumor on the Street to-day that there was to be a consolidation of the lighting and transportation companies in this city. The capitalization, it was said, will be $150,000,000. The following corporations are said to be in the new organization: Union Traction Company, $30,000,000; National Electric Company, $25,000,000; Electric Company of America, $25,000,000; Pennsylvania Manufacturing Company, $15,000,000; Pennsylvania Electric Vehicle Company, $10,000,000. William F. Harrity said he had heard some talk of the new concern, but that the plans were not matured yet, and that it would be improper for him to tell what had been done for several days. George Widener, of the Union Traction Company, spoke in a similar strain.

WESTERN UNION.—The gross earnings for the year ended June 30 amounted to $23,919,732, an increase of $1,380,873, and net earnings $6,090,151, an increase of $357,948, while surplus earnings after interest, sinking funds and 5 per cent. dividends, amount to $315,695, against a surplus the previous year of but $3848. Earnings this year, however, have not been up to last year's standard. For the first three months of 1899 net revenue increased but $50,000 to $1,250,000, whereas the increase in the three previous years ranged from $100,000 to $150,000. There was a deficit of $191,260 after the quarterly dividend payment of 1¼ per cent. The record for the nine months ended March 31 shows net earnings of $4,200,000, an increase of $350,000, but, after interest, sinking fund and dividend payments, there was a deficit of $123,775, against a surplus for the nine months of the previous year of $195,159. There is said to be good reason to believe that the Western Union treasury has been somewhat depleted the past two years, and there are rumors in telegraph circles that the dividend is to be reduced from a 5 per cent. basis to a 4 per cent. basis.

BOSTON AUTOMOBILE MANUFACTURING COMPANY.—Boston capital is now interesting itself in the Boston Automobile Manufacturing Company, with a capitalization of $750,000, divided into $500,000 7 per cent cumulative preferred stock and $250,000 common stock, both of par value of $100 per share. The company is incorporated under the laws of Maine, and will manufacture package delivery wagons, pleasure carriages and cabs to be run by electric power. The company has secured an option on a large plant which, it is alleged, will be promptly equipped with the necessary machinery for manufacturing. The company has secured some valuable mechanical devices which its managers think will prove of great advantage in the manufacture of automobiles. The company is offering its preferred stock at par through its fiscal agents, Messrs. W. O. Gay & Co., and gives as a bonus one share of common with every two shares of preferred. The transfer agents are the Massachusetts Loan & Trust Company, and the directors are Francis A. Osborn, Joseph B. Moors, D. Webster King, Cyrus G. Beebe and George D. Burrage.

CHICAGO TRACTION.—Although subscription books have not yet been opened, applications have been received for more of the stock of the new Chicago Traction Company than is to be alloted. As an indication of how the stock is regarded in the East, it may be stated that the Chicago agents have already had numerous applications for underwriting from New York and Philadelphia, where the allotments are said to be oversubscribed. It is understood that $2,500,000 or $3,000,000 of preferred stock will be allotted to Chicago investors. The same amount was allotted to Philadelphia, and the balance goes to the New York promoters and their friends. For the preferred stock taken at par the subscriber will receive as a bonus 50 per cent. of the amount in common. The preferred issue being $15,000,000, this disposes of $7,500,000 of the $20,000,000 common shares. The remaining $12,500,000 will go to the New York promoters for their work in organizing the company. It is officially announced that the preferred shares will receive 6 per cent. dividends. The promoters figure also that they will be able to make reasonable disbursements in a very short time on the common stock as well.

MEXICAN TELEPHONE ANNUAL REPORT covers results of operations for the year ended Feb. 28, 1899, and shows earnings thus: Telephone rentals, $130,026.24; tolls, $433.13; private lines, $4729.05; miscellaneous, $3749.25; total, $138,937.67; operating cost, $67,347.25; maintenance, 15,149.88; total disbursements, $82,497.13; net revenue, $56,440.54. These figures are in Mexican currency, and in comparison with the preceding year show increase of $10,573.23 in gross, $1704.14 in expenses and $8869.09 in net revenue. The company paid $35,782.02 for construction, against $9076.80 the preceding year and $6709.03 for taxes, against $6922. The net revenue in United States currency was $21,337.04, against $18,021.66 in 1897-98, $13,053 in 1896-97, and $10,424 in 1895-96. Remittances to home office in Mexican currency were $54,665.17, yielding in gold $25,492.23, against $43,713.73 Mexican and $20,269.71 gold the preceding year, an increase of $5222.52 gold. The year closed with value of Mexican dollars at their best. The company has no floating debt, and the only unpaid bills are current accounts not due. The company is operating exchanges in 18 cities, with 2726 subscribers, against 2486 a year ago, increase 240, and 2346 two years ago. Twelve of the exchanges increase, one is unchanged and five show small losses. The City of Mexico shows the largest gain, with an increase of 138 subscribers, while Monterey and Guadalajara also increase notably. To date $34,195.91 has been paid from earnings for installation of the metallic service.

THE STATE OF TRADE.—Dun's review of the week says: "To speak truly of business this week one must free the mind of stocks. For a severe decline in manufacturing stocks has created an impression that it has some relation to productive industry, but it has none. There was no change in the money market worth mentioning, and the volume of business shown by payments through the principal clearing houses was 71.5 per cent. larger than in 1892, the year of greatest prosperity hitherto, which is more than double the gain anybody considered possible a year ago. The rise in prices since 1892 accounts for only an insignificant proportion of the increase. Part of it is in speculative operations, but more than half in the quantity of products exchanged in legitimate business. Failures for the first week in May have been the smallest reported for any week in about six years, only $762,611 against $2,978,980 last year, $3,995,894 in 1897, and $4,138,271 in 1896. Manufacturing were $196,173, against $1,411,275 last year and $1,949,536 in 1897, while trading were $564,988, against $1,472,727 last year and $1,289,857 in 1897. Failures for the week have been 165 in the United States against 246 last year, and 20 in Canada against 24 last year. Railroad stocks were fairly steady, with earnings of United States roads reporting $40,116,748 in April, 4.2 per cent. larger than last year, and 17.2 per cent. larger than 1892, and for the first week in May earnings were 6.2 per cent. larger than in 1898, and 14.0 per cent larger than 1892. Eastbound tonnage from Chicago was slightly larger than last year, and nearly 60 per cent. larger than in 1892."

THE WEEK IN WALL STREET was one of the most sensational in a long series of years, by reason of its tragic climax in the death of ex-Governor Flower, the leader of the bull movement. At the beginning of the week the market experienced a general decline, attended by considerable liquidation of long stock. On Wednesday it rallied sharply on support by large interests and exceptionally large purchases for London. This fact was, however, apparently due to the existence of a large short interest in Americans in the foreign market, while covering by the local professional bears also contributed toward the recovery of prices. The European purchasing continued on Thursday, and there were also further evidences of support from the local leaders, but the market developed renewed hesitation and declining tendencies, its weakness centering in the stocks which would be affected should the Ford Franchise Tax bill become one of the laws of New York. On Friday the action of speculation was irregular. An early decline was checked by the strength of sugar and other manipulated stocks, and the expectations of a good bank statement also had an effect, but on Saturday almost all stocks went to smash on account of the sudden death of Mr. Flower, the news of which was not generally known until people read their morning papers. The result was that Wall Street closed the week in a very limp and demoralized condition, although there were sharp rallies toward the end, it being realized that this country's prosperity does not depend on any one man, however big and influential. During the week 15,543 shares of Western Union were sold, closing at 91⅝. General Electric was inactive, only 7900 shares being dealt in, but selling down to 115, a decline of 3 points. Meropolitan Street Railway on 62,928 shares showed a decline of 16⅛, closing at 218⅞. In Brooklyn Rapid Transit, a Flower specialty, there were enormous dealings, and on sales of nearly one million shares, the stock declined to 106½, a loss of 22½ points. In Boston American Bell Telephone sold off 10 points to 350 for the week, less than one thousand shares being traded. West End Railroad closed at 93. In Philadelphia Electric Storage Battery sold at 175 to 180 preferred, and the same for common. Union Traction sold between 41¾ and 42. Penna. Manufacturing Company sold at 25½, closing. In the New York outside market, Electric Vehicle Company preferred closed the week at 120 to 125 and common 112 to 115. Electric Boat preferred closed at 45 to 50 and common 22 to 25. New York Electric Transportation Company closed at 20½. New England, at 12¼.

Special Correspondence.

NEW YORK NOTES.

FIFTH AVENUE STAGE LINE.—It is stated that the Fifth Avenue Stage line has been sold to the Whitney-Widener-Elkins syndicate and that it has passed from the control of the Third Avenue interests to Metropolitan Street Railway men. The new management will utilize electric vehicles on the line.

POWER BRAKES FOR STREET CARS.—Tests of power brakes are to be made on the lines of the Metropolitan Street Railway Company, under the direction of the State Railroad Commission. More than 50 applications have been received by the Commission for permission to submit brakes to be so tested.

THE NEW YORK RAPID TRANSIT PROBLEM.—Mayor Van Wyck has signed the Marshall bill, which measure is an amendment to Section 73, Chapter 378 of the city charter. This section provides that no franchise of any kind shall be granted by the Municipal Assembly for a longer period than 25 years. As amended, it authorizes the Municipal Assembly, in its discretion, to grant a franchise or right to any railway corporation to use any streets of New York for the construction and operation of a tunnel railway for the period of 50 years, and any such grant may at the option of the city provide for giving to the grantee, the right on a fair revaluation to renewals not exceeding in the aggregate 25 years; provided, however, that such grant shall only be made after an agreement by the tunnel corporation to pay the city of New York 3 per cent. of the net profits after 5 per cent. of the profits upon the sum expended to construct the tunnel has been retained by the company. The Marshall bill allows the Long Island Railroad Company to depress its tracks in Atlantic Avenue, Brooklyn, to build a tunnel under the East River from the foot of that thoroughfare to Manhattan and to erect treminal stations in Maiden Lane and Cortlandt Street in Manhattan Borough. The cost of the improvement in Atlantic Avenue, Brooklyn Borough, would be about $2,500,000, of which the city would pay half and the railway company half. It is stated that as soon as Governor Roosevelt signs the bill—it is likely that he will—the Long Island Railroad Company will proceed at once with the construction of the tunnel under the East River. Mayor Van Wyck believes that this bill offers the best chance yet for the solution of the rapid transit problem. As soon as the bill is signed by the Governor, the Long Island Railroad officials will at once make an application to the Municipal Assembly for a franchise, and, it is stated, will lose no time in pushing the work both in Brooklyn, under the East River and at the New York terminal.

WESTERN NEW YORK NOTES.

MR. GODFREY MORGAN, of Syracuse, has been appointed temporary receiver of the Niagara Falls & Lewiston road, better known as the Gorge road, in place of Joseph R. Mergrue.

THE ACKER PROCESS COMPANY has made a lease of land and power with the Niagara Falls Hydraulic Power & Manufacturing Company and will at once erect a plant for the manufacture of caustic soda. About 3000 electrical horse-power will be used and the plant will be located on Third Street, not far from the power house in the gorge.

THE INTERNATIONAL TRACTION COMPANY has entered into an agreement with the Erie and Wabash railroads whereby a new right of way is secured between Buffalo and Tonawanda for the Lockport trolley cars. The new route will shorten the running distance between Buffalo and Lockport several miles, and its total length will be less than 25 miles. The Lockport cars will then be operated on the Main Street division of the Buffalo local system.

CLEVELAND NOTES.

MR. R. M. DOUGLASS, well known in street railway circles in the East, has become general superintendent of the lines of the Cleveland Electric Railway Company.

RAILWAY FRANCHISES.—The Lorain & Cleveland Electric Railway Company and the Lorain County Electric Railway Company have both asked for franchises to operate lines through the principal streets of Lorain.

EXTENDING INDEPENDENT TELEPHONE LINES.—The agents of the United States Telephone Company, of this city, are at work securing the right of way for a new telephone line which will run from Columbus to Toledo by way of Dublin, Marysville, Kenton and Findlay.

THE CRUSADE AGAINST HIGH SPEEDS IN THE STREETS.—During ten days twelve motormen of the Cleveland Electric Railway were arrested for exceeding the city speed limit of 12 miles an hour. The crusade against high speeds has had the desired effect, for, after a conference with the police officials, President H. A. Everett, of the company, announced that additional cars would be put on all lines, and that the speed ordinance would be strictly lived up to.

INDIANA NOTES.

THE FORT WAYNE ELECTRIC CORPORATION,—The final report of the receiver for the Fort Wayne Electric Corporation was filed with the clerk of the United States Court. The summary shows the total receipts were $261,367.94 and the disbursements $121,500.47, leaving a balance on hand of $139,867.47.

THE NEW TELEPHONE COMPANY, in Indianapolis, began service on May 9 with more than 1000 telephones in operation. The company gives an all night service. It expects to have 3000 instruments in service by the first of June. A number of former employees of the Central Union have taken service with the new company.

RAILWAY FRANCHISE GRANTED IN INDIANAPOLIS.—The Board of County Commissioners has granted a franchise for an electric railway for a short distance along the Allisonville road to Hon. C. L. Henry. The consideration is $25 per mile each year for repair purposes. This completes the line from Pendleton to Indianapolis, Mr. Henry having secured a private right of way for the greater distance.

THE ELECTION of directors and officers of the Broad Rifle Rapid Transit Company resulted in the selection of J.R. Henry, W. H. Schmidt and W. F. Millholland, of Indianapolis, and W. M. Bates and G. S. Philler, of Philadelphia, for directors. Mr. Schmidt was selected as president. Mr. Millholland, one of the directors, is the present secretary of the Indianapolis Street Railway Company. The Indianapolis company will at once begin improvements on the road and hopes to terminate the receivership this week.

THE INDIANA RAILWAY COMPANY, made up of the South Bend Railway Company, the General Power & Quick Electric Company, Elkhart & South Bend Railway Company, Indiana Electric Railway Company and Elkhart, Goshen & Southern Railway Company, consolidated April 15, has filed a blanket mortgage in the several counties to secure 1000 bonds of $1000 each, payable in 30 years. The mortgage is executed to the Pennsylvania Title & Trust Company as trustee and draws 5 per cent. interest.

DETROIT NOTES.

THE FULLER COMPANY, Detroit, reports that it has a large number of orders for its electrically driven air propellers, and is also very busy on forced draft work. It is now building a complete equipment for one battleship and one armored cruiser now under construction at Cramps' yard in Philadelphia for the Russian Government. In order to facilitate the rapid delivery of its goods to the trade, the company is making large additions to its works. It is also about to place upon the market an entirely new type of automobile vehicle, which will be a first class production in every respect. The company also has orders for the complete electrical equipment, including signaling apparatus for a large passenger steamer and two freight steamers for the lake service.

PRESIDENT GEORGE E. FISHER, of the Chase Construction Company, Detroit, states that the company is very busy on several large contracts. It is completing the outside construction and underground system for the city of Grand Rapids, Mich., having the general contract for this large municipal installation. The complete plant will cost $154,000. The Chase Company will move its large equipment of construction tools and machinery to Cleveland, where it has a contract to build the Cleveland & Eastern Railway. This road will be 36½ miles long, 28 miles of which is built over private right of way. The Chase Company has recently completed the municipal lighting plant for the city of Sturgis, Mich., and also has a contract for a lighting and power plant to be operated by water power at Belding, Mich. This plant is to be run in connection with the Lowell plant, which was constructed by the Chase Company three years ago. Mr. Fisher reports that the general outlook for business is excellent, although the high price of copper and steel has held back several railway projects that are ripe for construction. The company has a contract for the track laying, ballasting, etc., on the Dayton & Xenia road, but the promoters were unable to make satisfactory financial arrangements and the Chase Company declined to proceed with the work.

MESSRS. FIELD & HINCHMAN, consulting electrical and mechanical engineers, Majestic Building, Detroit, are now receiving bids for four boilers, two engines and direct connected 100 or 125-kw generators, and two 2-hp motors for the extension of the plant of Parke, Davis & Co. Bids will soon be received on ten boilers, four automatic stokers, heat regulation, electric wiring and heating and ventilating plants in the new schools, and for remodeling the heating and ventilating plants of three old schools in Detroit. A contract has recently been closed by the firm for a large electric sign under its specifications for the Detroit Soap Company. The letters will average 6 feet by 8 feet in size, a total of 316 lamps being required. A test was recently made at Richmond, Mich., on the village lighting plant. This installation comprises a Wood boiler, Ball engine and a 75-kw two-phase Westinghouse alternator. The streets of this village are lighted by 26 lamps of the alternating enclosed arc type. Messrs. Field & Hinchman have recently completed an electric lighting plant for the illumination of the works of the Detroit City Gas Company, and are now preparing specifications for work in connection with an exhibition electric light and power plant for the Gas Company's office building. This plant will be operated by a gas engine direct-connected, in all probability, to a generator which will supply current for operating a motor to run machinery and for ventilating purposes, as well as for incandescent lights to illumine the exhibit. The firm has many other contracts under way and is preparing plans and specifications for a system of street lighting for the village of Grosse Pointe Farms.

CHICAGO NOTE.

ELECTRICAL VEHICLES IN CHICAGO.—It is stated that within 60 days the Illinois Electric Vehicle Transportation Company, which is conducting the local business for the Columbia Automobile Company, will have between 100 and 200 vehicles running in the streets of Chicago, and a probable fare of 25 cents per mile per passenger will be charged. The carriages are being built at the Studebaker works at South Bend, Ind., and at an eastern factory. As soon as the cab service has become established, the corporation will branch out into an automobile delivery wagon business.

ST. LOUIS NOTES.

THE DAY LINE OPEN FOR BUSINESS.—The Day Electric Railway Company made the first run between Belleville and East St. Louis on May 8. Better time than was expected was made.

PRIVATE ELECTRIC CAR BURNED.—The Southern Electric Company's private car "Electra" was partially destroyed by fire, and will be reconstructed in the next two or three weeks. The car caught fire on the night of May 7 in the sheds of the company. The roof and curtains, upholstering, etc., were destroyed.

NEW SYNDICATE LINE CARS.—The National Southern Electric Railway Company has begun work on the numerous changes to be made in its system of street railway lines. The materials, cars and rails to convert the Broadway cable into an overhead trolley line have been ordered, and it will be extended south, giving the road 27 miles of single track. The Northern Central and Union lines are to be newly equipped with big cars; the Citizens' line will have a new loop on Broadway, Elm, Seventh and Walnut Streets; the Southwestern line will be extended to the cemeteries, and the Southern's new branch will run to Carondelet, while it and the Broadway line will partly change routes in the south end of town. The Southern Electric and National Railway companies control eight lines—the Cass Avenue & Fair Grounds, the Union, the Northern Central, the Citizens', the Southwestern, the Baden, the Broadway and the Southern Electric.

TEXAS AND MEXICO NOTES.

AN ELECTRIC LIGHT PLANT is to be installed in the town of Caborca, state of Sonora, Mexico. Mr. D. E. Morineau is the projector of the enterprise.

UNDERGROUND TELEPHONE WIRES IN AUSTIN.—The wires of the Southwestern Telegraph & Telephone Company in Austin, Texas, are being placed underground.

THE NEW TELEPHONE LINE between Otumba and San Juan Teotihuacan, Mexico, was inaugurated on May 5 with befitting ceremonies. The completion of this line forms a connecting link between all the cities and towns in that part of Mexico.

THE NEW ELECTRIC LIGHT PLANT in the National Palace, City of Mexico, Mexico, was formally opened on the night of May 5. Arc lights are located in the corridors and Ambassadors' Hall, while in front of the building 2500 incandescent lights are artistically distributed.

REDUCTION IN TELEGRAPH TARIFF.—The Mexican Telegraph Company on May 1 reduced its rates to the United States, Canada and British Columbia to $3.62 for ten words and 25 cents for each additional word. The old rate was $3.85 and 26 cents. The tariffs of the company are on a gold basis and the recent reductions are due to the fall in the rate of exchange.

TO ENLARGE A MEXICAN POWER PLANT.—The greatest electrical power plant in Mexico is said to be that of the company called the "Potencia Electrica," near the city of Pachuca, in the state of Hidalgo. This plant supplies power to the Difficultad, San Rafael and Baron mines and a number of factories. The power will shortly be increased to supply the pumps of the Cabrera mine. When the installation of this machinery is completed and the Cabrera pumps are in operation the revenue of this electric power company will be materially increased.

FRANCHISE TAX DECISION.—Judge R. B. Green, of the district court at San Antonio, Texas, has rendered a decision in the suit of the San Antonio Street Railway Company against the city of San Antonio to enjoin the defendant from collecting taxes on the franchise of the company. The decision was on the exceptions of the city to the petition of the plaintiff, the exceptions being sustained and the suit dismissed. The same order was entered in the suit of the Mutual Electric Light Company against the city, the cause of action being the same. The plaintiff in each case excepted and gave notice of appeal.

WATER POWER DEVELOPMENT IN MEXICO.—A number of important electrical power projects are on foot in the immediate vicinity of Guadalajara, Mexico. In order to increase the water supply during the dry season, the outlet of Lake Chapala, which forms a great reservoir 30 miles wide and 80 miles long, has been dammed and raised three feet, and now supplies, the year round, an amount of power greater than can be utilized. Messrs. Fernandez del Valle & Bros. are arranging to develop 10,000-hp of this power by installing an electric power plant. They will employ one-half of this power in their cotton mills, and the other half they will transmit into the city of Guadalajara. Messrs. Francisco Martinez Negrete & Sons, of Guadalajara, are having plans made to enable them to develop 6000-hp by installing an electric plant in the barranca upon a branch of the Rio Grande. This power will be utilized in the cotton mills now operated by these gentlemen.

PACIFIC COAST NOTES.

THE PORT ANGELES TELEPHONE COMPANY recently applied for a franchise in Port Angeles, Wash. The Sunset Telegraph & Telephone Company has just been refused a franchise in that town.

A PROJECTED 60-MILE ELECTRIC RAILWAY.—An electric railroad from Eugene, Ore., to Siuslaw Bay, a distance of 60 miles, is projected. It would carry great amounts of freight to the Bay for shipment to San Francisco.

THE UTICA MINING COMPANY, Angels Camp, Cal., has been allowed a license to erect poles for transmitting electric power from Union Lake to the mine at Angels. A telephone franchise was also granted the company, which will install a line giving connection with San Francisco, via San Andreas.

THE BEAVER MINING COMPANY, composed largely of Standard Oil magnates, is credited with an ambition to drive a 7000-foot tunnel through Elkhorn Mountain. Power for the drills is to be obtained from an electric plant to be installed on Pine Creek, it is said. The mine is near Baker City, Ore.

ENLARGING THE UNION IRON WORKS ELECTRIC PLANT.—The capacity of the electric power plant of the Union Iron Works, San Francisco, is to be considerably increased, and foundations are being laid for an addition to the main power station. A large proportion of the machinery in the works is electrically driven.

110-MILE TRANSMISSION PROPOSED.—It is reported on seemingly good authority that the Standard Electric Company, of California, has made an agreement with the San Francisco Gas & Electric Company, whereby the Standard Company will supply all of the current required by the latter company. The Standard Company holds a controlling interest in the Blue Lakes Water Company, which has a long-distance transmission system in operation and is soon to supply Stockton, Cal., with electric power. It is said that the capacity of the present plant will be more than doubled in the near future, on account of the prospects of transmitting current to San Francisco, a distance of 110 miles. A new water power electric plant will be constructed, to be operated under a head of 1400 feet. A large force of men is engaged in improving the hydraulic facilities and preparing for construction.

CANADIAN NOTES.

ELECTRICAL AMBULANCES IN TORONTO.—The police commissioners of Toronto, Ont., have decided to purchase an electrical ambulance. Should this vehicle prove satisfactory, all the police patrol wagons of the city will be operated by electric power.

A TORONTO SYNDICATE is now negotiating with the St. Hyacinthe, Quebec, Hydraulic Power Company, as well as with the gas works company of that town, for the purchase of both plants. The offer made is in the neighborhood of $175,000. The Toronto Company proposes to very materially enlarge both plants and thus reduce the present cost of production.

ELECTRIC POWER TRANSMISSION IN QUEBEC.—The masonry of the dam across the Jacques Cartier River at St. Catherine's Quebec, has been completed, and four 54-inch water wheels of the most modern type are to be used to develop power. It is proposed to deliver in Quebec, for electrical purposes, 5000-hp. The work will probably be completed by July next, at a cost estimated at about $275,000.

POSSIBLE STRIKE OF STREET RAILWAY EMPLOYEES.—The agreement made last November between the Electric Street Railway Company, of London, Ont., and its employees expired on May 11, and the men offer a new agreement, in which they ask recognition of the union and an increase of pay. The company is strongly opposed to recognizing the union, and as the men are said to be anxious for such recognition, it is pretty certain that a strike will result.

NEW ELECTRIC RAILWAY FOR ST. JOHN, N. F.—Mr. R. G. Reid, of Montreal, has just concluded arrangements for the immediate construction of an electric tramway in the city of St. John, N. F. Contracts have been made with the Messrs. Lariviere, of Montreal, for cars of improved style; with the Westinghouse people for electrical apparatus; with the Canada Switch Company for the necessary trucks, and with Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, for plant. The power to operate the line will be generated at a point eight miles from St. John, and it is the intention to have a system first class in every respect. The railway will be opened in the early fall.

THE ENGLISH PACIFIC CABLE.—Great Britain's sudden reversal of policy on the Pacific cable question, volunteering a subsidy of $100,000 per annum toward any deficit which might arise in the operation of the cable instead of a straight contribution as was expected, has awakened a lively interest in the subject on the part of the Province of British Columbia. The Canadian Premier has received from the Government at Victoria, B. C., an offer to give the equivalent of about one-half the expected Imperial contribution, namely, two-eighteenths of the total cost. British Columbia thus proposes to assist the realization of the scheme by a contribution of nearly $1,000,000 beyond what is involved in her share of Dominion responsibility.

ELECTRIC POWER APPLICATIONS IN HAMILTON.—The B. Grening Wire Company, of Hamilton, Ont., had installed in its works, about three months ago, a 40-hp "S. K. C." two-phase motor, obtaining current from the Cataract Power Company. The motor has worked so satisfactorily that the company has placed an additional order for one 50-hp, one 30-hp, and one 20-hp motor of the same type, to work its entire works by electric power. The Gurney-Tilden Company, of Hamilton, is also having installed in its works one 30-hp, three 15-hp and one 7-hp "S. K. C." two-phase motors, which are to drive the machinery and elevators in the works, entirely replacing steam power. At this rate Hamilton will soon be a smokeless city, as the engines of the Hamilton Electric Light & Power Company were closed down in March last, and have not been in operation since, everything being driven by the large "S. K. C." motors, with power supplied from the De Cew's Falls plant.

THE SHAWINIGAN WATER & POWER COMPANY, of Montreal, Que., has just let contracts which will involve an expenditure of over $300,000. This contract, which is only a preliminary, is for the canals, bulkheads, foundations for power houses, etc., required to develop 30,000-hp, and a railway to connect the Shawinigan Falls with the Great Northern Railway, a distance of four and a half miles. The successful tenderers were Warren, Scharff & Co., and, though they obtained the contract only a few days ago, they have already sublet contracts for rails, ties and other supplies. They intend to push the work with all possible speed so as to finish it within seven months. The development of the power at the Shawinigan Falls, situated on the St. Maurice River, about 17 miles from Three Rivers, Que., will have a great effect in stimulating manufacturing in the Province of Quebec, for it is estimated that at least 100,000-hp can ultimately be efficiently utilized. It is understood that the company has already closed a contract for the sale of a large amount of power, sufficient, in fact, to warrant the expenditure called for on the works given to Warren, Scharff & Co.

General News.

THE TELEGRAPH AND TELEPHONE.

PIQUA, OHIO.—The Piqua Home Telephone Company has been organized here, with a capital stock of $75,000.

NEW BREMEN, OHIO.—The New Bremen Telephone Company has been organized, with a capital stock of $6000.

DUBUQUE, IOWA.—The Standard Telephone Company has been granted a franchise to establish an exchange in this city.

EAST HAVEN, CONN.—The East Haven Telephone & Electric Company has been organized here, with a capital stock of $1000.

MONTEZUMA, IOWA.—The Northern Telephone Company, of Pocahontas County has been incorporated, with a capital stock of $10,000.

DULUTH, MINN.—The exchange of the Duluth Telephone Company was destroyed by fire on May 1. The company's loss is about $25,000.

JERSEY CITY, N. J.—An ordinance is now before the mayor for his approval, authorizing the Hudson Telephone Company to lay conduits through the principal streets of this city.

BLUE EARTH, MINN.—The Blue Earth Valley Telephone Exchange Company has sold to the Northwestern Telephone Exchange Company its toll lines in the Blue Earth section of the state.

SIOUX CITY, IOWA.—The Home Telephone Company's system, with headquarters in this city, is to be sold to a syndicate, including Mr. T. H. Johnson, the present manager of the company.

CLARION, IOWA.—A proposition to grant a 25-year franchise to the Wright County Telephone Company was defeated at the polls recently. The citizens do not wish to grant the franchise for so long a time.

OKLAHOMA CITY, OKLA.—A telephone line is being built from Oklahoma to Shawnee by the Oklahoma City Telephone Company, and a connection will be made with the Missouri & Kansas line at this place.

WINSTON, N. C.—A telephone line will be built connecting Winston-Salem with all the towns in the Piedmont section north of here, by the Mutual Telephone Company, which has just been organized in this city.

LAWRENCE, MASS.—Among the recent incorporations in this state was the Home Telegraph & Telephone Company, of this city, with a capital stock of $100,000. Mr. E. W. Burton, G. G. Adams and Henry Klous are the incorporators.

NEW FLORENCE, MO.—The People's Telephone Company, of Montgomery County has applied for a charter. Its capitalization is $5000. Mr. T. M. Marlow, of Americus, was elected president, and Howard Ellis, secretary and treasurer.

CAYUGA, IND.—The Cayuga Telephone Company has been sold to Mr. E. Russell and Mrs. Margaret B. McMahon, of Covington, who are now in possession of the property. A new 100-drop Eureka switchboard will be installed in the exchange.

LITTLETON, W. VA.—The Exchange Telephone Company, of Littleton, has been organized, with a capital stock of $25,000. The principal stockholders are B. J. Farrell and Hiram Chaney, J. A. Connelly, D. R. Meighan, E. L. Robinson, all of Littleton.

MINNEAPOLIS, MINN.—The Mississippi Valley Telephone Company will have its exchange in operation in this city by June 1 and the first thousand telephones will be connected by that time. The company is at the present time laying conduits and drawing in cables in the uptown districts.

ARCHBOLD, OHIO.—The Archbold Telephone Company has been organized to build lines from Archbold to Stryker, Bryan and Edgerton, Ohio. The capital stock is $10,000, and the incorporators are Frank B. Ufer, Charles McLaughlin, J. C. King, Fred J. Ballmeyer and A. J. Murback, all of Archbold.

BINGHAMTON, N. Y.—The Binghamton Telephone Company has been organized, with a capital stock of $100,000, to operate a telephone system in Broome, Tioga, Chenango and Delaware counties. The directors are Thomas B. Crary, G. C. Bayless, C. F. Terhune, C. F. O'Brien and W. W. Newell, of Binghamton.

LAPORTE, IND.—Representatives of Southern Michigan and Northern Indiana independent telephone corporations met here recently to adjust rates and consummate plans for the extension of the service. The various corporations determined to amalgamate interests in the building-up of an extensive system in the two states.

WEST UNION, OHIO.—The Acme Telephone Company is the name of a new concern organized here to construct telephone lines in Adams, Brown, Highland and Pike counties, this State. The capital stock is $10,000 and the incorporators are E. A. Crawford, T. W. Ellison, W. K. Coleman, Charles E. Campbell, F. R. Hillhouse, all of West Union.

McMINNVILLE, TENN.—The McMinnville Telephone Company has bought out the Smithville Telephone Company, and the line running from Smithville to Sulphur Springs and thence to Dibrell. The line will be extended at once to McMinnville. The Dixie Telephone Company and the Gainesboro Company also have their headquarters at McMinnville, thus making this city the telephone centre for this section of the state.

WILMINGTON, N. C.—The Interstate Telephone Company has purchased the plant, franchises, etc., of the Elmira Telephone Company, which runs from Raleigh to Goldsborough by way of several towns. The purchase is made to avoid the necessity of constructing a new line from Goldsborough to Raleigh, in order to give these two places and Wilmington the benefit of an intercommunicating system. The Elmira Telephone Company's line has heretofore been operated by the Bell Company.

ELECTRIC LIGHT AND POWER.

AKRON, OHIO.—At a recent election in Doylestown, Ohio, it was voted to bond the village for $10,000, to build a municipal electric light plant.

HAVANA, CUBA.—A despatch from Puerto Principe states that an American syndicate has secured the electric lighting franchise in that city for $70,000.

PIERRE, S. D.—The Milner Electric Company has been organized here, with a capital stock of $5000. The incorporators are George Milner, E. L. Squire and W. L. Shunk.

MALONE, N. Y.—The Malone Light, Heat, Power & Coal Company has been formed out of the consolidation of the Malone Light, Heat, Power & Coal Company and the High Falls Electric Company. The company's capital is $75,000.

DETROIT, MICH.—The Grand Trunk electric power house at the terminal station in this city was almost entirely destroyed by fire on May 2. Until the plant is rebuilt the company will obtain its light from the Excelsior Electric Company.

MT. GILEAD, OHIO.—The Mt. Gilead Electric Light, Heat & Power Company has been organized, with a capital stock of $50,000. The incorporators are W. M. Carlisle, M. Burr Talmage, A. A. Whitney, S. P. Gage, H. S. Griffith, all of Mt. Gilead.

THE NATIONAL LIGHT & POWER COMPANY has been incorporated in New Jersey, with a capital stock of $15,000,000. The incorporators are Karl Roswell Miner, New York; Frederick L. Austin, Jersey City, and Frank B. Dobbins, Rahway.

JEFFERSON CITY, MO.—The Pure Ice, Coal & Electric Lighting Company has been organized in Caruthersville, Mo., with a capital stock of $18,000. The incorporators are Otto L. Seyppel, Seyppel, Ark.; T. G. Sedgwick, E. H. Slater, C. B. Faris, all of Caruthersville.

SOUTH BEND, IND.—The Oliver Hotel, in this city, will have a very complete electric plant. Two 60-hp and one 100-hp engines, direct connected to generators, furnish the power. The Ball Engine Company, Erie, Pa., furnishes the engines and the General Electric Company the generators.

CREIGHTON, NEB.—The Creighton Electric Light & Power Company expects to soon begin work on the construction of a large pond on Bazile Creek near this place, which will, when completed, furnish sufficient power to give Creighton a first class electric light and power system. This will enable the company to extend its service, which it has heretofore been unable to do on account of the lack of power.

THE ELECTRIC RAILWAY.

NEW HAVEN, CONN.—The Winchester Avenue Railway Company has increased its capital stock from $600,000 to $800,000.

BOSTON, MASS.—The railroad commissioners have approved the modified plans of the Boston Elevated Railroad for the construction of the elevated system.

LANCASTER, PA.—The City Councils have been petitioned by the People's Electric Railway Company for the right of way to build new lines over various streets in the city.

HUDSON, N. Y.—The Hudson Electric Railway has been reorganized for the purpose of consolidating with the other companies interested in the proposed Albany & Hudson line.

WASHINGTON, D. C.—It is said that the Georgetown & Tenallytown Railway Company will extend its road from Tenalleytown to Rockville, the county seat of Montgomery County.

NEW LONDON, CONN.—The Superior Court of New London County has decided in favor of the public necessity and convenience of the Norwich & New London parallel electric railway.

ELIZABETH, N. J.—The City Council has granted to Senator John Kean a street railway franchise. An eight-cent fare to Cranford will be charged until 1905. After that date the fare will be five cents.

DARBY, PA.—The Borough Council has passed an ordinance giving to the Philadelphia, Morton & Swarthmore Street Railway Company the right to construct and operate an electric road in Darby Borough.

TOLEDO, OHIO.—Mr. Walker P. Hall, of Cincinnati, has secured the lease of the Put-in-Bay water works, light and railway company. He bid $2600 for the use of the property during the summer. The lease is for the electric railway only.

RICHMOND, VA.—The Norfolk, Willoughby Spit & Old Point electric railway has been sold to Mr. R. Lancaster Williams, of Richmond, and associates. The price is said to have been in excess of $100,000. Mr. Williams will assume the presidency.

COLUMBUS,, OHIO.—The Central Ohio Electric Railway Construction Company has been incorporated here, with a capital stock of $10,000, by Will J. Dusenbury, John J. Dun, George S. Gugle, Eugene N. Morgan, F. S. Wagenhals, all of Columbus.

DOVER, DEL.—The American Electric Railway Company has submitted a proposition to the citizens of Kent County to build a road connecting the towns with Woodland Beach and Bowers Beach. The company also proposes to submit propositions for lighting the towns.

VALPARAISO, IND.—President Morrison, of the Chicago, Hobart & Valparaiso electric railway, states that the line will be built during the spring. Eastern capitalists will furnish the money. This road will give direct communication with Chicago, via Hammond.

GALION, OHIO.—The Ohio Central Traction Company has been organized to build a street railway line here. The capital stock is $225,000, and the incorporators are Israel A. Kelsey, Dennis A. Blakeslee, W. E. Haycox, Robert W. Johnston, A. N. Lewis, all of Galion.

SEATTLE, WASH.—The Front Street Cable Railway Company has petitioned the City Council for a 50-year franchise to introduce the electric system on its lines which are operated at present by cable power. The company states that it will expend $65,000 to $100,000 in making the change.

ROCHESTER, N. Y.—It is stated that an electric railway will soon be in course of construction to connect this city with Lewiston and Niagara Falls. The proposed line will be under the control of the Cuyler-Morgan syndicate. The road may be run in connection with the Rochester Railway Company.

COLORADO SPRINGS, COLO.—A syndicate of Colorado Springs capitalists has purchased the Cripple Creek District electric railway and will immediately extend it to Colorado Springs. It has 25 miles of track reaching the principal mines. The surveyed route to Colorado Springs is 29 miles in length.

EVANSVILLE, IND.—Mr. H. D. Morgan, general manager of the Evansville Street Railway Company, has been appointed receiver of that property. Judgment was obtained for $26,000 indebtedness to John Elliott Bowers of New York. The property is bonded for one million dollars and is covered by a blanket mortgage.

WABASH, IND.—The Indiana Street Railway Company, which has absorbed the electric railway lines between South Bend and Elkhart and Elkhart and Goshen, has filed articles of association. It is said to be the purpose of the company to build an extension from Goshen southeast to Lake Wawasee, a distance of 15 miles.

TERRE HAUTE, IND.—Boston capitalists are seeking permission from the Commissioners of Vigo County, Ind., to construct an electric railway between Terre Haute and Brazil. The distance is a little over 16 miles. It is stated that the necessary permission will be granted, and it is the company's intention to begin this work in a few weeks.

JERSEY CITY, N. J.—Judge Kirkpatrick, of the U. S. District Court, has ordered the sale of the rolling stock and assets of the New Jersey Electric Railway Company, which owns the line rom Rutherford to Paterson. The road has been in the hands of a receiver since December, 1897. The lowest bid that will be considered will be $1,000,000.

SYCAMORE, ILL.—The DeKalb County Board of Supervisors has decided in favor of granting a franchise to the Geneva Lake, Sycamore & Southern Electric Railway Company. The term of the franchise is not known as the company was incorporated under the general railway act when the Allen law was pending. It yet remains to be decided.

PITTSBURG, PA.—The Consolidated Traction Company, of this city, has granted to over 1000 thousand employees an advance in wages of 11 per cent., dating from May 1. This advance will give the conductors and motormen 20 cents per hour. The men employed in the power houses will be granted a reduction of hours without any decrease of pay.

LA PORTE, IND.—A syndicate of capitalists is being organized to build an electric railway from Goshen, this State, to Toledo, Ohio. Pittsburg capitalists are to build lines connecting Northern Indiana cities and the prediction is made that there will ultimately be electric railway communication between Toledo and Chicago, a consolidation of interests being probable.

DEXTER, N. Y.—The Brownville & Dexter Street Railway Company has been granted a franchise to construct a street railway between the two places named. The new road will be operated in connection with the Black River Traction Company which now runs from Watertown to Brownville. It is expected that the cars will be running to Dexter by June 15.

JERSEY CITY, N. J.—The Corporation Counsel has submitted an opinion that the property of the Jersey City & Bergen Street Railway Company in Jersey City, which is valued at $700,000, is subject to taxation by the local assessors. Heretofore the company has claimed exemption from local taxation and has been taxed by the State Board of Taxation.

PITTSBURG, PA.—The Consolidated Traction Company has placed upon its lines two cars to carry local freight. Other cars will be put into service as required. The plan is to eventually make house-to-house deliveries along the routes, but for the present freight stations have been established. A city freight service is also to be instituted on the United Traction line.

NORRISTOWN, PA.—The Schuylkill Valley Traction Company has been reorganized, with the following named officers: N. H. Larxelere, of Norristown, president; Horace C. Jones, of Conshohocken, secretary and treasurer; A. G. Davids, general manager. New capital to the amount of $50,000 has been secured, and it will be used to improve the line and add more rolling stock.

BOSTON, MASS.—The Gardner, Westminster & Fitchburg Street Railway Company has been incorporated, with a capital stock of $100,000. The road will be ten miles in length and will run from Gardner, through Westminster to Fitchburg, with a connecting line to Wachusett Lake. The incorporators are J. A. Stiles, F. S. Coolidge, E. F. Blodgett, Charles Heywood, G. R. Damon and H. L. Pierce.

MT. VERNON, N. Y.—The Board of Alderman has granted a 50-year franchise to the New York, Westchester & Connecticut Traction Company, which is a branch of the People's Traction Company, of New York. There was much confusion in the board while the franchise was under consideration. The franchise enables the company to enter the city, a privilege for which it has been struggling for more than a year.

PITTSBURG, PA.—The Monongahela Street Railway Company has awarded the contract for the construction of the Wilkinsburg & East Pittsburg Street railway to Messrs. Booth & Flynn, Limited. The company expects to have the cars running by Sept. 1. The line will be four miles long, extending from Wilkinsburg to East Pittsburg, and will run through the towns of Edgewood, Swissvale, Hawkins, North Braddock and East Pittsburg.

PROVIDENCE, R. I.—It is stated that the consolidation of street railways in eastern Massachusetts has been practically completed. The consolidation is on the basis of $22,000,000, and the total trackage will be 700 miles. The consolidated system will extend from Newport, R. I., to the northeastern Massachusetts state line. The Union Traction Company and its connecting lines in Rhode Island and across in Massachusetts are not included in the consolidation.

MILWAUKEE, WIS.—A mortgage for $5,000,000 has been filed by the Milwaukee Light, Heat & Traction Company in favor of the City Trust Company, of New York. It covers the property and franchises of the Milwaukee & Wauwatosa Motor Railway, the North Greenfield & Waukesha Electric Railway, the Waukesha Electric Railway, the Waukesha Beach Electric Railway, the Wauwatosa Rapid Transit Company, the Milwaukee & Wauwatosa Motor Electric Company, the North Greenfield & Milwaukee Electric Railway, the Milwaukee, Racine & Kenosha Railway, the Belle View Street Railway and the Milwaukee Light, Heat & Traction Company.

LEGAL.

ELECTRIC EXPRESS CARS.—Justice Marean, of the Supreme Court, Brooklyn Borough, has rendered a decision in favor of the defendants in the action of Mrs. Aaron de Grauw against the Long Island Electric Railway Company and others, to enjoin them from operating express cars on the street surface railways in Jamaica, Long Island. He holds that the authority given to the railways to "convey persons and property" comprehends the conveyance of property unaccompanied by persons.

OBITUARY.

EX-GOVERNOR R. P. FLOWER, of New York State, who has been so active of late years in financial work, much of which affected lighting and traction interests, died suddenly last Friday while taking a spell of rest at Eastport, L. I. He had been out fishing, and, after a hearty lunch, became ill, dying in a few hours. He was 64 years of age. He was the son of a New York wool carding and clothing manufacturer, and in early life taught school and did everything possible to advance his own fortunes in the world. He bought a jewelry store at Watertown, N. Y., drifted into banking and soon became a Wall street power as well as a leader in Democratic politics. After serving in Congress he was elected Governor of this state and, soon after the expiration of his term became Subway Commissioner in this city. During the last two or three years he has been the chief "bull" financier in the country and has done a great deal to organize such properties as Brooklyn Rapid Transit, Kings County Electric Light Company, etc. He had taken little part recently in politics except to insist on sound money as a plank in the Democratic platform. He leaves a very large fortune to his family, and of late had done much for charity, his most notable work being the building and endowment of the Flower Hospital.

Trade and Industrial Notes.

THE BALL ENGINE COMPANY, Erie, Pa., has a number of foreign orders, consisting of engines for Russia, Japan, Mexico and Venezuela.

MR. C. S. KNOWLES, Boston, Mass., has lately been appointed general eastern agent for the Lakon Company, of Elkhart, Ind.

THE CHICAGO PNEUMATIC TOOL COMPANY has purchased the patents formerly owned by the Consolidated Pneumatic Tool Company, now defunct.

THE DAVIS ELECTRICAL WORKS, Springfield, Mass., which has been shut down for some time, has resumed operations. The company will be reorganized.

MR. BENJAMIN ROSE has closed a contract with the Western Electric Company, of Chicago, to install a complete electric light plant in the Rose Building, Cleveland, Ohio.

THE EDDY ELECTRIC MANUFACTURING COMPANY, of Windsor, Conn., has never been so busy as it is at present. Last month it did more business than any month since it began manufacturing.

MR. JOHN C. BOSS, president of the Lakon Company, Elkhart, Ind., reports a decided improvement in business over last year. Mr. Boss expects to attend the National Electric Light Convention in New York.

THE DIAGNOSTIC ELECTRIC LAMP COMPANY has been incorporated in New York City, with a capital stock of $2500, by John W. Morrison, New York; Jacob Felsenstein, Baltimore, and Edgar Poe Reese, New York.

THE EDWARD FORD PLATE GLASS WORKS, of Toledo, Ohio, have recently purchased from the Ball Engine Company, Erie, Pa., a 175-hp tandem compound engine, arranged for direct connection to a General Electric generator.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY, of Meriden, Conn., has just received an order from the Paterson, Passaic & Suburban Telephone Company for a 1000-drop switchboard and about 250 new instruments to go with it.

THE COLUMBIA AUTOMOBILE COMPANY, of Hartford, Conn., is completing its new buildings with all the despatch possible, much larger manufacturing facilities having become absolutely imperative to take care of the large number of orders the company has on hand.

THE NEW OFFICE of the C & C Electric Company in Chicago will be at 828 Monadnock Block, where Mr. E. Sanderson, the company's new manager,

will be glad to welcome all the old friends and customers of the company. Mr. Sanderson will look after all the territory tributary to Chicago.

THE TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., reports that it is very busy in both its telephone and switchboard departments. Its business is constantly increasing and it is now making preparations to double the capacity of its plant during the next 60 days.

THE JENNEY CONSTRUCTION COMPANY, of East Orange, N. J., has been organized, with a capital stock of $50,000, to manufacture automatic alarms and electric apparatus. The incorporators are S. Hallam Jenney, Lucian W. Jenney, Elbert A. Brinckerhoff and Duncan T. McLaren.

THE PHOSPHOR BRONZE SMELTING COMPANY, Limited, 2200 Washington Avenue, Philadelphia, Pa., is sending out to the trade its revised phosphor bronze price list. Owing to the continued high price of copper, the company has been compelled to withdraw all previous quotations.

MR. R. KUHN, of the United Electric Heating Company, Detroit, Mich., reports a decided increase in the electric heating business. He states that the company has more business now than at any time in its history, and that an addition to its operative force has been necessary, in order to properly take care of the increase.

THE NATIONAL PIPE BENDING COMPANY, of New Haven, Conn., is finding the demand for the National feed-water heater steadily increasing, and that train load of heaters which it recently shipped to the Boston Electric Light Company has brought the company into very prominent notice among electrical engineers and central station men.

THE FORT WAYNE ELECTRIC WORKS, with its principal office at Schenectady, N. Y., has been incorporated at Albany, with a capital stock of $500,000, to manufacture electrical and other apparatus. The directors are: Henry Paul, C. S. Bash and J. W. White, of Fort Wayne; S. D. Greene, J. P. Felton, E. E. Gilbert and George C. Hollister, of Schenectady.

THE MILLER-KNOBLOCK COMPANY, South Bend, Ind., reports that it is busy in its electrical department. It is doing a very heavy repair business in electrical mining machinery, and is weeks behind with orders for assembled commutators for street railway motors. Mr. O. M. Knoblock or Mr. A. W. Morrell will attend the National Electric Light Convention in New York.

THE SMITH & EGGE MANUFACTURING COMPANY, Bridgeport, Conn., has purchased the entire control of the electrical business formerly carried on by O. H. Platt, who has manufactured for years the New England switch. The Smith & Egge Company will now manufacture this switch, and is at present busy getting tools and jigs ready for their prompt and economical production.

THE ELECTRIC GAS LIGHTING COMPANY, of Boston, has secured new quarters for its factory in an entirely fireproof building. Thoroughly equipped with new machinery and increased facilities, the management states it will be but a few weeks before all goods will be turned out regularly and promptly. Other than special goods are being shipped from the stock in the company's warerooms.

THE CHASE-SHAWMUT COMPANY, of Boston, whose organization was noted recently, is gradually getting its facilities into working order, and its combined forces have already straightened out the many difficulties attending consolidation. It is now fully prepared to supply junction boxes, circuit breakers, controllers, tested fuse wire and fuse links, switches, switchboards and a number of other specialties.

THE HARDY LAMP COMPANY, Pittsfield, Mass., manufacturer of "Hardy" incandescent lamps, is making plans to increase the output of its plant to 3000 lamps per day. It is said that this make of lamps has met with a very gratifying reception by consumers and the trade. These lamps hold their initial candle power with a very small percentage of drop, and, as a rule, burn out before dropping 20 per cent. in candle power.

THE CHICAGO VEHICLE COMPANY has been incorporated at Trenton, N. J., with an authorized capital of $1,000,000. Of the stock $400,000 is preferred, with 5 per cent. annual dividend. The company is formed to manufacture and sell and operate all kinds of vehicles. The incorporators are Orson O. Fox, Smith C. Shadrick, John Trier, Gustave Lukas, M. M. Chesrown, J. W. Creekmur, all of Chicago, and David Harvey, Jr., Asbury Park, N. J.

THE JOHN H. McGOWAN COMPANY, Cincinnati, Ohio, is sending out a neat booklet on its pumping machinery. Various types of pumps are well illustrated through the pages. The catalogue contains references to those designs for which there is a current demand. In addition to the pumps illustrated and described, the company supplies combinations of the single-cylinder, duplex and flywheel types for larger capacities and higher ranges of pressure, as well as special pumps for special service.

GARTON LIGHTNING ARRESTERS.—The Garton-Daniels Company, Keokuk, Ia., reports that since April 1 the sales of Garton lightning arresters have been over double what they have been in the same period of any previous year. In order to keep up its stock the company has recently doubled its force of employes, and states that it will be able to meet any requirements for prompt shipments. Its new kicking coils and lightning arresters for the protection of small motors, fans, etc., are meeting with a large demand.

SILK MAGNET WIRE.—The immense growth of the independent telephone exchange business has created a very large demand for the fine sizes of silk magnet wire used in telephone apparatus. The Electric Appliance Company, Chicago, realizing the importance of this demand, has recently closed arrangements with a large factory devoted exclusively to the manufacture of fine sizes of silk magnet wire to handle its entire output. This places the company in a position to sell on the ground floor to large manufacturers of telephone apparatus and it has already closed some excellent contracts.

THE ELECTRIC ARC LIGHT COMPANY has moved its general offices to larger quarters in the Bowling Green Building, 11 Broadway, New York. It has also largely increased its manufacturing facilities and is now in position to promptly ship direct and alternating current enclosed arc lamps. Mr. W. C. Hubbard, the general manager, reports that the company is very busy at present and has just closed some good orders with large concerns, including W. & J. Sloane, Ogden Goelet estate and the Central Railroad of New Jersey, in New York; the Palais Royal, Washington, D. C., and Campbell & Smith, Herran Brothers and John Davis & Sons, Pittsburg, Pa.

THE PROVIDENCE GAS COMPANY, Providence, R. I., has placed contracts with the Berlin Iron Bridge Company, of East Berlin, Conn., for a new meter house, 65 feet wide, 110 feet long; a purifier house, 40 feet wide and 175 feet long and three stories high; and also for a gas holder building 184 feet in diameter. The entire construction will be steel framework and fireproof. The Berlin Company is also putting up a new machine room for the Duncan Company, at Mechanicville, N. Y. The building is 72 feet wide, 170 feet long; the roof trusses being arranged with trolley beams and hoists, so that the rolls of paper can be lifted in and out of the machines by power.

THE ILLINOIS ELECTRIC COMPANY, which is the Chicago agent for Lundell fan motors, states that it has received its first shipment of 1000 motors. It has arranged an attractive display of the various sizes and styles of these fan motors in its sales room, at 239 Madison Street, Chicago, Ill. Mr. Healy, president of the company, says that there is every indication that this will be one of the most lively and prosperous seasons in the electrical supply business, particularly that part of it relating to fan motors. The Illinois Electric Company's business extends over a vast territory tributary to Chicago, the volume of business each month showing an extremely gratifying increase over that of the previous month.

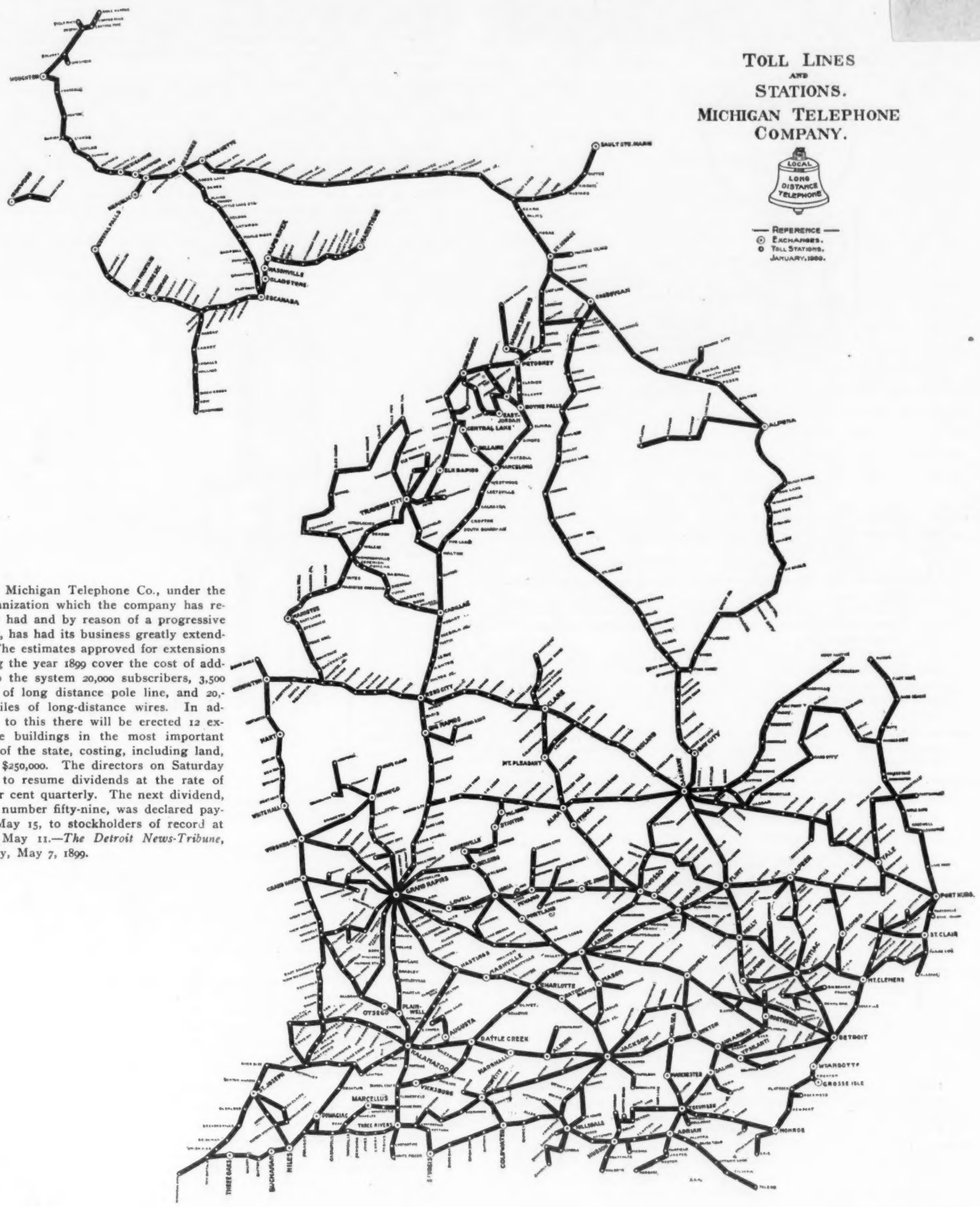
THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, reports that it is receiving more orders for its new alternating current enclosed arc lamp than it can fill, and has been compelled to refuse a large order for export to Great Britain on account of its inability to supply the home demand. A large shipment of these lamps and a number of direct-current enclosed arcs were recently made to Japan. The advantages of the new alternating current enclosed arc lamp are pointed out at the Electrical Exhibition at Madison Square Garden, New York, at the Adams-Bagnall Electric Company's exhibit, which is in charge of Mr. O. W. Phipps, 222 Havemeyer Building, New York, the company's Eastern representative.

A MODERN POWER STATION AT TARIFFVILLE, CONN.—A. C. Rice, consulting engineer, of Dayton, Ohio, has prepared plans and specifications for developing a water power and building a power station on the Farmington River, near Tariffville, Conn., for the Hartford Electric Light Company, Hartford, Conn., and the contracts were placed on April 26. The Engineering Contract Company, 41 Broadway, New York, was awarded the contract for the dam and power station; the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, the contract for the wheels, governors, feeder, waste gates and racks, and the Westinghouse Electric & Manufacturing Company, the electrical machinery. The plans call for a concrete dam, about 35 feet high, with the power station of concrete steel and brick. There will be two generators of 1000-hp each and two exciters of 46-hp each, with a traveling crane to handle all the parts. The power station will be heated with hot water and the machinery will be cleaned by means of compressed air. It will be one of the best and most attractive power stations in New England.

THE VINDEX ELECTRIC COMPANY, Chicago, has issued a neat little pamphlet on its transformers. The details of construction are given in concise language and the illustrations show transformers from 300 lights' capacity down to 20 lights. Curves are also given, showing that the temperature of the '99 type of Vindex transformer, and the core loss, are much lower than the data as to what should constitute a good transformer published by Prof. D. C. Jackson, of the University of Wisconsin. The curves show that the core loss is excelled in all sizes, while at the same time the regulation of the transformer is much better than that specified by Prof. Jackson. Another curve of a 200-light Vindex transformer shows very high efficiency. By reason of the unusually low induction employed in the design of this company's '99 type of transformer and the high efficiency attained at high frequency, its standard transformer for 125 cycles operates very satisfactorily and with high economy at a frequency as low as 60 cycles. The highest degree of refinement, however, cannot be obtained without transformers of special design for both frequencies; therefore, the company manufactures two types, one for 60 cycles and the other for 125 cycles. The company is backed by experience, technical ability and a complete factory equipment. The officers are: W. H. Hornberger, president and general manager; L. E. Lemon, secretary and electrical engineer; C. A. Hornberger, treasurer.

THE FERRACUTE MACHINE COMPANY, of Bridgeton, N. J., has for several years past made a specialty of presses and dies for producing armature disks and other electrical goods, and has built up a large trade in this line of machinery. It has made a full line of patterns for large double crank presses, which are built on the composite system, so that presses may be furnished with distances varying from 34 inches to 100 inches between columns, and with corresponding holes in beds. Some of these are built with round beds for circular disks and others with oblong beds for arcs or parts of circles. They are built both with and without gearing and from light and heavy patterns. These have proved very popular and the company has placed a large number of them in the factories of the General Electric Company and the Westinghouse Electric & Manufacturing Co., and in many other factories. A number of these large presses have also been sent abroad. These are known as "S" or stamping presses. The company also makes a line of "C" presses for cutting out smaller disks and builds a special machine with indexing attachment for notching disks for various sizes from 4 inches to 48 inches diameter. The beds of these can be extended so that disks up to 96 inches can be notched on the outer or inner edge. These machines are fully described in the Ferracute Company's new catalogue 12, which has just been issued. A line of heavy punching presses for all kinds of instrument work, and a large line of double action presses for making shells, cups and other deep-edged work are also made by the Ferracute Company. This company's line of presses embrace about 300 different sizes and kinds, and it has introduced a number of features in its machinery especially adapted for electrical work.

The directors of the Michigan Telephone Company have authorized the building of 3,500 miles of pole line and 20,000 miles of wire, connecting every city and town in the state with from one to ten circuits, as will be seen by the following diagram of the pole lines.



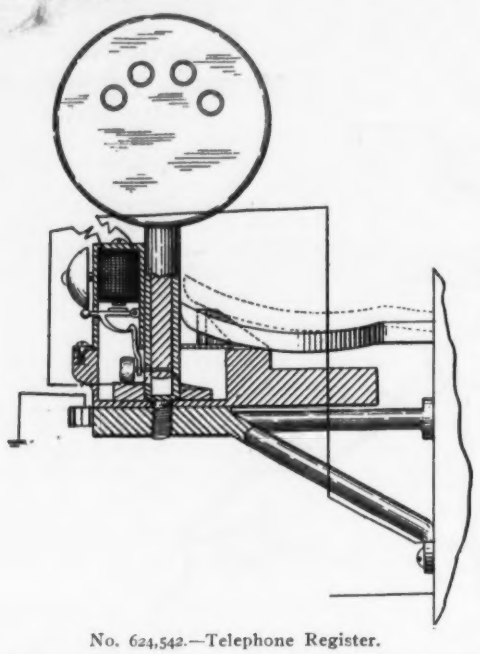
The Michigan Telephone Co., under the reorganization which the company has recently had and by reason of a progressive policy, has had its business greatly extended. The estimates approved for extensions during the year 1899 cover the cost of adding to the system 20,000 subscribers, 3,500 miles of long distance pole line, and 20,000 miles of long-distance wires. In addition to this there will be erected 12 exchange buildings in the most important cities of the state, costing, including land, about $250,000. The directors on Saturday voted to resume dividends at the rate of 1¾ per cent quarterly. The next dividend, being number fifty-nine, was declared payable May 15, to stockholders of record at noon May 11.—*The Detroit News-Tribune*, Sunday, May 7, 1899.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 9, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

624,463. INCANDESCENT LAMP; E. F. Dwyer, Lynn, Mass. App. filed March 9, 1899. The filament of the lamp is bent into a coil, the middle point of which is securely fastened to the lamp stem between the points where the leading-in wires project therefrom, for the purpose of giving stability to the filament.



No. 624,542.—Telephone Register.

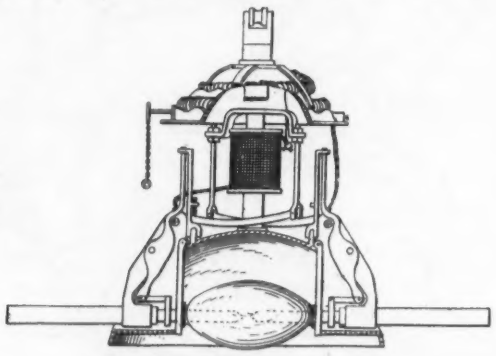
624,516. APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY; Guglielmo Marconi, of London, England. App. filed Jan. 5, 1899. (See Current News and Notes.)

624,531. ELECTRICALLY-OPERATED RUDDER-CONTROLLING MECHANISM; Richard B. Painton, of Williamsport, Pa. App. filed Sept. 13, 1897. The armature of a motor is built on the rudder shaft, the motor being reversible and capable of slow rotation. By means of a geared brake arrangement, the rudder is locked at any desired position when current is cut off from the motor.

624,542. TELEPHONE REGISTER; H. T. Richards, New York, N. Y. App. filed March 6, 1899. There is provided at subscriber's station a registering device which cannot be controlled except by a joint effort of the central office operator and the subscriber, which thereby prevents any question by either party as to the accuracy of the record.

624,552. COMPOSITION FOR CARBONS OF ELECTRIC LAMPS; Anton O. Simonnier, of Vienna, Austria. App. filed Feb. 15, 1899. (See Current News and Notes.)

624,561. STEP-BY-STEP PRINTING TELEGRAPH; W. S. Steljes, London, Eng. App. filed Feb. 16, 1899. A specific construction of the electro-



No. 624,703.—Electric Arc Lamp.

magnets and its armatures to allow of its being operated by very light reverse currents from a magneto machine; also means for shifting the type wheels along their axes to bring one wheel into acting position when the other is moved away from that position.

624,574. GALVANIC BATTERY; J. Sully, New York, N. Y. App. filed Jan. 27, 1899. A two-fluid cell in which the containing vessel is of carbon, the same being provided with an arrangement of tubes whereby one fluid may be drawn off from the bottom and the other from the top.

624,652. ALTERNATING CURRENT MOTOR; A. Heyland, Frankfort-on-the-Main, Germany. App. filed Feb. 28, 1898. A method of starting and running an alternating current motor having sets of inducing windings, consisting in supplying current first to those portions only of each set of the inducing windings in closest inductive relation to the other inducing windings, and thereafter supply current to the other portions of said sets of inducing windings.

624,660. TELEPHONE SYSTEM; F. A. Lundquist, Chicago, Ill. App. filed Sept. 20, 1897. Details of construction whereby the operator at central office knows every time the line is put into use and can make the proper charge against each subscriber so using it.

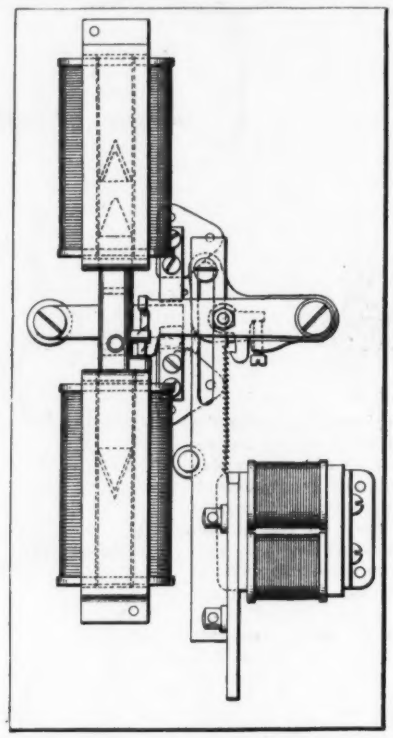
624,696-7. TELEPHONE TRANSMITTER; James H. Spencer, of New York. App. filed Nov. 30, 1898. (See Current News and Notes.)

624,703. ELECTRIC ARC LAMP; E. Tefel, Bennett, Pa. App. filed April 26, 1898. The carbons are arranged horizontally, the arc being enclosed in an air tight globe. A special feeding mechanism is provided, also an improved shade.

624,719. CONTROLLER; T. Von Zweigberk, Cleveland, Ohio. App. filed Feb. 20, 1899. The controller contains two cylinders adapted to be moved in succession by a single handle; one cylinder carries the "series" rheostatic contacts while the other carries the "parallel" contacts.

624,744. STORAGE OR SECONDARY BATTERY; Henry Blumenberg, Jr., of New York. App. filed Aug. 18, 1898. (See Current News and Notes.)

624,813. MEANS FOR REGULATING SPEED OF ELECTRIC MOTORS; O. C. Immish, London, Eng. App. filed March 7, 1898. The motor receives



No. 624,895.—Automatic Magnetic Circuit Breaker.

its current from a main and secondary battery and the controller is constructed to connect the secondary battery so as to either augment or oppose the current of the main battery, also to cut out the batteries for the purpose of regulating speed.

624,815. COMMUTATOR BRUSH HOLDER; G. H. Jantz, W. Liest and O. W. Jantz, Cincinnati, Ohio. App. filed Feb. 11, 1899. A bolt passes through the brush which secures it to the end of a spring through which the current passes from the brush; another spring-pressed arm holds the brush against the commutator.

624,824. ADJUSTABLE VIBRATOR FOR MAGNETIC COILS; C. A. Keller, Cleveland, Ohio. App. filed Dec. 5, 1898. The vibrating arm is attached to a post whose position is adjustable, for the purpose of regulating the distance between the making and breaking contacts.

624,838. ANNUNCIATOR FOR TELEPHONE SWITCHBOARDS; W. Meissner, Chicago, Ill. App. filed Nov. 11, 1898. Details of construction for the provision of sensitive drop.

624,881. TELEPHONE SYSTEM; Daniel M. Therrell, of Atlanta, Ga. App. filed April 5, 1899. (See Current News and Notes.)

624,895. AUTOMATIC MAGNETIC CIRCUIT BREAKER; W. M. Scott, Philadelphia, Pa. App. filed July 28, 1897. In connection with an ordinary type of circuit breaker means are employed for bringing into circuit, upon the occurrence of a predetermined overflow, an electrically actuated retarding device. A certain definite period of time is required to bring into circuit a supplemental high resistance coil which will immediately actuate the switch. In case the overflow subsides before the high resistance coil has been brought into circuit, the retarding device will be kept out of circuit, and the different parts will assume their normal position.